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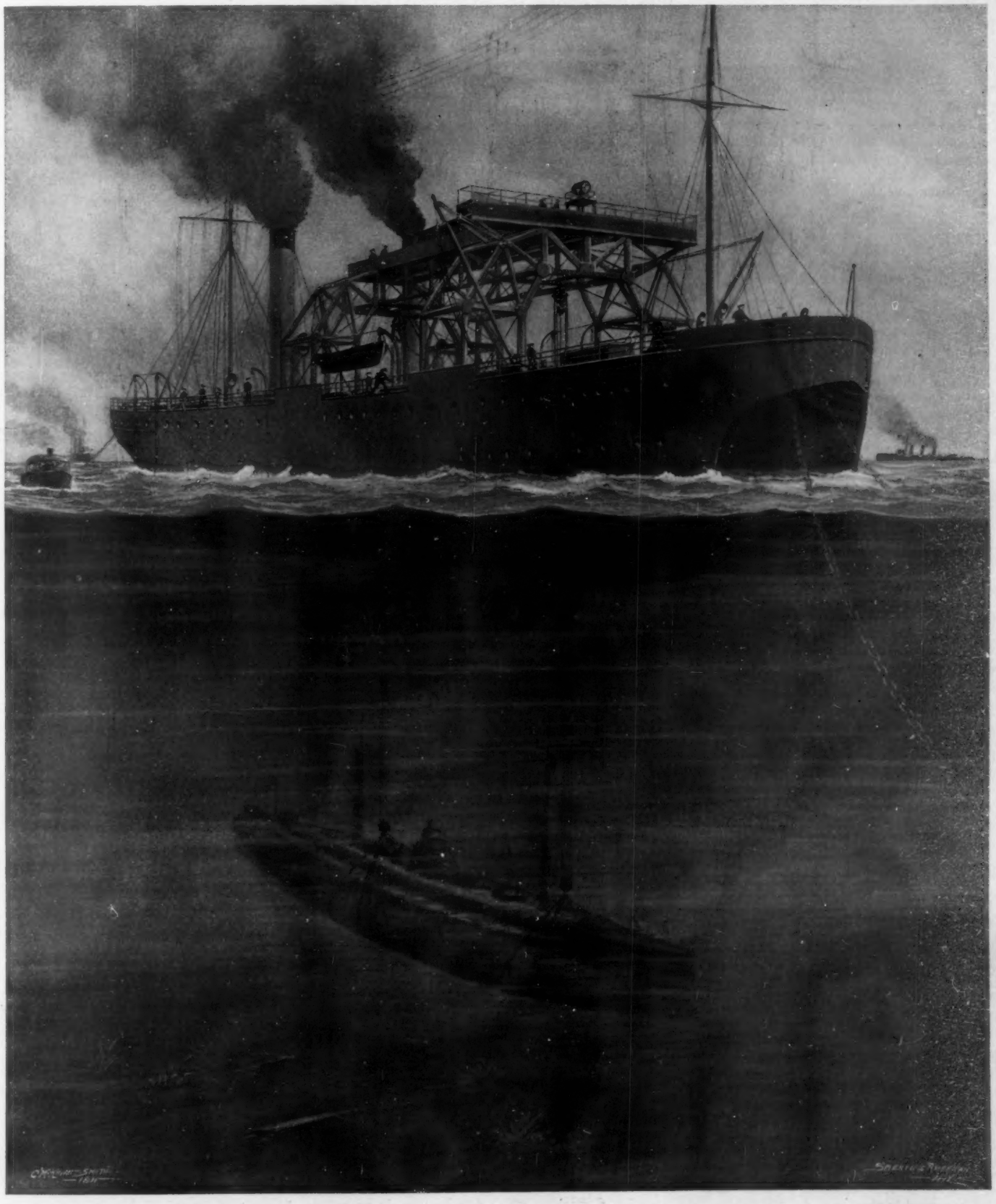

The "Vulcan," a self-propelling, floating dock, for salving submarines, recently raised, in three hours time, the sunken submarine "U. 3." The wreck was lifted by powerful tackles, electrically operated, and drawn up within a well in the center of the "Vulcan." Twenty-seven lives were saved.

RESCUE OF A GERMAN SUNKEN SUBMARINE

[See page 87.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record, accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Reefing Aeroplane

THE speed of the aeroplane has reached a point at which the need is felt for some system of "reefing," by which the area of the supporting surfaces can be varied to suit the various speeds at which the machine may be flying. This demand for a variable surface is due to one of the most important of the laws of flight; namely, that the area of the necessary supporting surface of an aeroplane varies inversely as the square of the velocity. This principle, affirmed by Langley and embodied in his great work "Experiments in Aerodynamics," has been disputed by some European theorists and practical aeroplane builders; but the experience of the last two years seems to verify it. If the law hold good, the standard Wright aeroplane, which, with about 500 square feet of surface, has a speed of 40 miles per hour, at 60 miles would need only 222 square feet for support, and at 100 miles per hour, only 80 square feet.

Now, that the law is generally correct, or at least that it does not produce too great a reduction of surface, is shown by the two very interesting racing machines exhibited and flown by the Wright brothers at Belmont Park last autumn. One of these, a semi-racer with a speed of 60 miles an hour, was provided with only 150 square feet of sustaining surface. The standard Wright machine, driven at 60 miles an hour, would need, according to the law, 222 square feet of surface. Its weight, however, with operator and full fuel and water supply, is 1,075 pounds; whereas the 60-mile semi-racer weighs with operator and fuel only 760 pounds. The difference in weight would largely account for the reduction of the area of the 60-mile racer, from 222 down to 150 square feet. Further verification of the law is found in the Blériot racer, which, with slightly less speed, and a weight of about 650 pounds with operator, also has but 150 square feet of sustaining surface. It is significant that in the actual racing machine, which is 15 miles an hour faster, the Wrights did not venture to reduce the supporting surface any further, both the semi-racer and the racer having 150 square feet of surface. The racer, however, is heavier, weighing, with operator and fuel, about 900 pounds.

If, then, the high speed flyers of 1910 have endorsed the Langley law, it follows that there will be a still further reduction of area in the racing machines of the future. If the standard Wright machine with 500 square feet of surface, could be driven at 100 miles an hour, it would need only 80 square feet of surface for support, and if a speed greater than 100 miles per hour were accomplished, the sustaining surface would come down to a pair of long, narrow blades, approximating in form to the wings of the swift or the swallow.

But it must be remembered that these reduced surfaces are equal to their work only if the machine is being driven at its highest, or at least at a high, velocity; and they are therefore theoretically too small to lift the machine from the ground or allow it to return safely thereto at the lower speeds which are necessary in starting and alighting. Proof of this was shown in the accident which disabled the Wright racing machine at the time of the contest at Belmont Park for the international trophy, when the stopping of the motor and the sudden slowing down of the biplane caused the machine to drop so swiftly to the ground that its momentum partially wrecked the machine and threw the aviator from his seat. Probably, having been accustomed to the larger-surface Wright machine, he did not realize that he should descend with his main planes at a large angle of incidence in order to check the velocity. In any case, it is evident that, if the racing aeroplane reaches a speed of 100 miles an hour, it will be necessary for safe control, to provide it with some means for enlarging or reducing the supporting area proportionately to the speed.

The problem should not be so very difficult of solution. The additional surface could be arranged to be drawn under or within the main surfaces either from the ends or from the rear. If, as we believe, the machines of the future will be built entirely of metal, the problem will be so much the easier to work out; but it should not be impossible to arrange some system of "reducing canvas" in the present type of machine, by drawing the furled surfaces into such a form that they will not offer any material head resistance.

A large percentage of the accidents to the existing machines are due to descending and landing at too great an angle or at too great a speed. Were it possible voluntarily to increase the surface at the time of making a landing, the risk of accident from this cause would be largely reduced.

Emancipation of the Truck Horse

ON entering the Madison Square Garden automobile show and looking over the superb exhibit of motor trucks and other commercial vehicles, we were impressed with the conviction that if the "horseless age," of which we have heard and talked so much recently, is not already upon us, it must be very near at hand. The impression of power, capacity, and speed was instantaneous; and we felt, as many another visitor to the show must have done, that what steam and steel had done on the railroad, gasoline and the rubber tire were destined to accomplish upon our streets and thoroughfares. There came to mind the story of the southern negro who, on seeing the first electric car to be shipped to the South, exclaimed: "These northerners are a mighty wonderful people. First they free the negro, and now they've freed the mule." If the commercial trucks exhibited at the Garden can show in daily service the endurance and capacity which are claimed for them on grounds of theory (and many carefully-conducted tests would indicate that they can), we may look for a steadily increasing substitution, for the horse-drawn vehicle, of the motor-driven truck and delivery van.

In the development of new industries there generally occurs some critical period in which, because of the final mastery of some difficult and essential elements, the art experiences a sudden and very decided development, and thereafter progresses by leaps and bounds to take its place among the leading industries of the time. Such a period occurred in the development of the passenger-carrying automobile, and there are well-defined indications that the present year marks a similar stage of progress in the development of the commercial vehicle. Strong proof of this is found in the fact that whereas in previous years, exhibitors of commercial vehicles were usually accommodated in a gallery or in the basement of Madison Square Garden, this year the number of exhibitors was so great that it became necessary to split the exhibit into two periods, extend the time to two weeks, and to give up the whole of the second week to commercial vehicles.

Perhaps the most marked impression left by this exhibit is a sense of the high character of the mechanical work, both as regards the care and intelligence shown in the design and the excellence of the materials and workmanship, in which respects these locomotives of the highway compare favorably with the engines of the steam railroad. In comparison with the railroad locomotive, the motor truck enjoys the great advantage that it does not have to develop the tools, the material, the shops and the workmen that are necessary to its own fabrication. All of these it finds not only ready to hand, but eager to place themselves at the service of the new and promising industry; and it is because of these conditions that the motor truck, just as soon as it had proved itself in actual service, developed into the perfected machine which can be seen in so many forms and sizes at the Madison Square Garden show.

The high class workmanship to which we have referred characterizes practically the whole of the exhibit, which covers a surprisingly wide variety of vehicles, from the diminutive single-cylinder, tricycle delivery truck, operated by one man, up to the huge ten-ton milk and coal trucks for handling heavy merchandise in bulk. A truck of the last-named capacity was exhibited, and at the present time ten of these huge vehicles are hauling coal in and around New York city, the combined capacity of which for a day's service is one thousand tons of coal. These ten trucks alone mean the elimination of at least sixty of the largest and heaviest truck horses from the city streets—a consideration which shows how rapidly the growth of the industry will serve to reduce congestion and improve sanitary conditions.

The great variety of uses to which the commercial vehicle is being put is strikingly shown at the Garden; for, aside from the impressive exhibit of five and ten-ton trucks for carrying coal, butchers' supplies, and other heavy freight, there were ambulance wagons, fire engines, hose carts, police patrol wagons and delivery wagons designed for a wide range of service. The smaller vehicles are frequently equipped with double-opposed horizontal motors, the larger with four-cylinder motors ranging in power from 20 to 45 horse-power. Among the exhibits that attracted special attention was a 3-ton motor truck, with a removable loading box, which can be quickly rolled on and off the truck—an arrangement which greatly reduces the time of loading and enables the truck to be kept in continual operation. Another novelty was a car whose power plant is built as a complete unit, and is so mounted in the chassis that it can be quickly disconnected and removed, the front or buffer plate of the frame being hinged and capable of being swung open to allow the engine to be bodily withdrawn. The object of this arrangement is to make it possible, on announcing the breakdown of a truck from the nearest telephone booth, to have a duplicate engine shipped to the truck, mounted and connected up—the last operation requiring only a few minutes' time. The builders of this truck place themselves under a rather heavy guarantee, that the owner shall not lose a day should the motor break down.

The important section of the exhibit reserved for electric vehicles gave striking proof that the storage battery is making a bold bid for recognition, not merely in the field of pleasure vehicles, but also for heavy commercial work.

The electric pleasure vehicles were chiefly of the light runabout type, and some dainty and beautifully-finished exhibits were shown in this line. Particularly attractive was a four-seated, closed, electric carriage, offered for the very moderate price of $1,750, and credited with a mileage per charge of 75 to 90 miles; also a new four-passenger brougham equipped with a direct spur-gear drive. An exhibit in this section which was viewed with great interest was the new Edison battery, which was shown upon several types of pleasure and commercial vehicles. An Adams express wagon which had been in daily use for several years and had made a trip from Washington to New York was one of the noteworthy electric vehicles using Edison's cells.

Historical exhibits of pleasure cars and of bicycles were two of the features of the second show. The development of the latter from the "hobby-horse" of 1846 to the speedy motorcycle of to-day, of which a score of different makes was exhibited, was interesting in the extreme.

By no means the least encouraging feature of this year's exhibition was the fact that although the aisles and booths were well filled with visitors, a large majority of these were either interested in the design or manufacture of commercial vehicles, or were present or prospective users of the same.

Why This Neglect?

WHY is it that the Diesel motor, which must be considered as one of the triumphs of German mechanical genius, has been so greatly neglected in this country that there is to-day no American firm engaged in its manufacture? Here is a new type of motor, sound in principle, economical and durable in operation, guaranteed both in laboratory tests and under various conditions of commercial operation, which for some reason or other, has been totally neglected in the United States. In proof of this durability, we quote our contemporary, *The Engineer*, which in a recent issue refers to the test of a 250-horse-power, two-cylinder Diesel motor, that ran continuously for seven and a half months, from April to November of last year. During this period, neither the valves on the air compressor nor the pistons or cylinder covers were removed, and even the bearings were not inspected. We are at the dawn of a motor-driven ocean steamship era, and it is the Diesel motor which is being installed in the fine vessels now building for ocean service. Is the United States to have no part in this development?

Sir Francis Galton. F.R.S.

The Passing of a Peer in Science

SOLEMN tidings come to us across the sea. On January 18th, at the ripe age of eighty-nine, Sir Francis Galton, prince and patriarch among contemporary men of science, has passed out of his earthly sphere of action. Mingled with our sense of loss, are feelings of gratitude for our rich heritage, the life-work of a man of genius, freely given, in generous and unstinted abundance, a monument to him, to us a seed from which shall spring a harvest of a value we know not yet to gage.

It is well at such moments as this to pause and take time for brief meditation upon the life of the one who has completed his labors; to pick out from among the infinite variety of the world's progress and activities that strand which is woven into an individual unit by the character of one strong man, doing his large share in shaping the destiny of the nations.

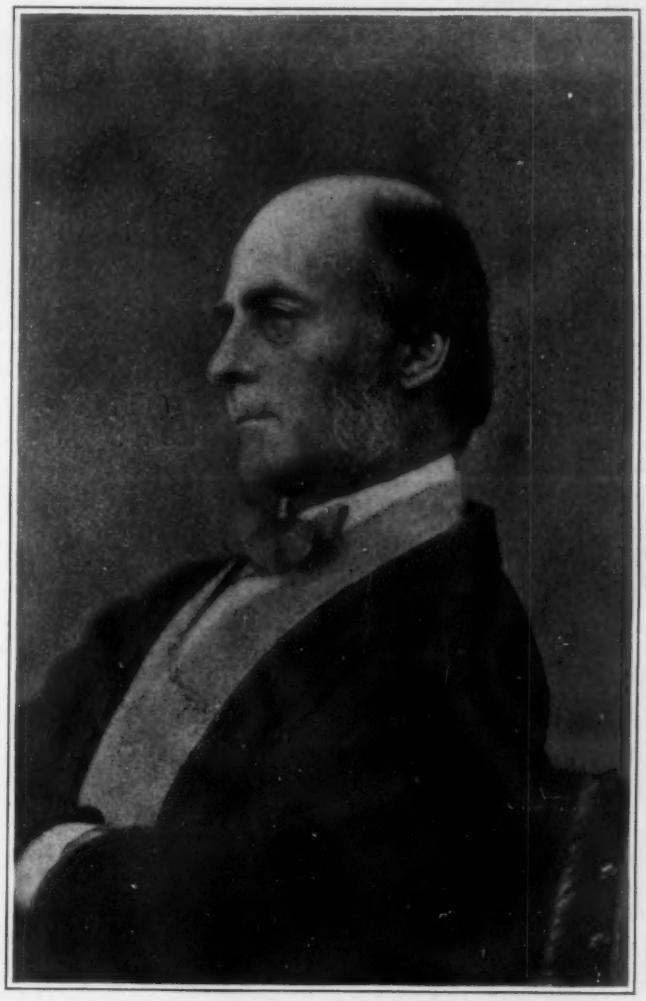
Sir Francis Galton was himself a striking illustration of a phenomenon to the study of which some of his main efforts were directed—an instance of "hereditary genius." His grandfather, Samuel John Galton, is described as a "scientific man of business of a statistical turn of mind." He accumulated a considerable fortune, which testifies to his commercial talent, and which became indirectly the means, in the liberal hands of his descendant, of financing several of the scientific enterprises of which the latter was the generous patron.

Samuel John Galton was a fellow of the Lunar Society, a private club formed for the discussion of scientific and philosophical topics, and including such illustrious men as Priestley, Watt and Erasmus Darwin. The last mentioned was Galton's maternal grandfather by a second marriage. By first wedlock he was also grandfather to the great Charles Darwin. There is a close relation between Galton's extensive studies in heredity and Darwin's monumental works on evolution, a relation which we should hardly be disposed to ascribe to pure accident, and which itself probably represents an instance of similar characters inherited from common ancestors. More of the nature of coincidence, though none the less interesting, is the fact that the Austrian Abbot Mendel, whose name is now so constantly referred to in connection with the law of inheritance of unit characters, was born in 1822, the same year which gave Francis Galton to the world.

After receiving his early schooling at King Edward's School, Birmingham, the sixteen-year-old boy was placed by his father into pupilage at the General Hospital of the same city to prepare him for the medical profession. In his "Memories of My Life" Galton presents to us a quaint picture of these days, illuminated in a genial and oft-times humorous light. He tells an anecdote how in his early enthusiasm he resolved to make himself thoroughly familiar with the properties of all the drugs in the Pharmacopœia by taking a small dose of each, beginning at the letter A, and going right through the alphabet. His enterprise, however, was brought to an abrupt conclusion before he had completed the letter C—by a dose of two drops of croton oil, the effect of which discouraged further experiments of this kind. On another occasion he relates how a severely injured man was brought to the accident ward in a state of deep intoxication, and how the drunkard later awoke from his stupor to find that his legs had been amputated while he was unconscious. The significance of this occurrence, which did not fail to strike the young medical student, is apparent when it is remembered that it took place before the day of anæsthetics. A period at King's College, London, and at Trinity College, Cambridge, completed the young man's academical education. At Cambridge much of his energy was devoted to mathematics, with the application of which to biology the name of Francis Galton will be forever closely linked.

It was intended that he should receive a part of his training abroad, and for this purpose he was sent to study at Giessen under the famous German chemist Liebig. But his work there did not seem to proceed very much to his satisfaction, and he made a rather sudden resolve to change his plans completely, and spend the time allotted to him in traveling in the Orient. This move, in the light of later events, was significant, for among Sir Francis Galton's great achievements are his geographical travels and explorations in Egypt and the Soudan (1844 and 1901) and Western South Africa (1850). The latter was undertaken under the auspices of the Royal Geographical Society, but financed by Galton himself. In acknowledgment of the personal services rendered by him in these pioneer advances into the dark continent, the explorer received his first official distinction, the Gold Medal of the Royal Geographical Society (1853).

The greater part of Galton's life, however, was spent in the prosecution of his various anthropological studies. These originated with his inquiries into hereditary genius, but led indirectly to a number of separate problems and results. Some of these have become familiar to the general public, though their association with Galton is less well-known. Thus it is he who introduced into general use in England the system of identification by "thumb prints" (originated by Sir William Herschel), after working out with great labor the details necessary for its successful use. To him also is due the method of producing "composite photographs" of a type of individuals, such as members of one family, or a collection of portraits of criminals, so as to bring out the characteristic features common to the group. But there can be little doubt that of all the creations of this fertile and broad-spirited mind, the greatest gift from him to humanity is that branch of science—we are inclined to say that scientific creed—to which its author has applied the name "eugenics." In the Minutes of the University of London eugenics is defined as "the study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally."



SIR FRANCIS GALTON, F.R.S.
Born February 16th, 1822; died January 18th, 1911.

One conclusion which is brought home with great force by such studies in heredity as Galton pursued is the immense force for good or for evil of a man's ancestry, and the opportunities, hitherto so little heeded, of improving our race by proper attention to these facts. This is the bright side of the picture. Its dark side frowns down upon us when we consider how, under present condition, types of lower value to the community contribute a full quotum to the new generation, while the best types are through various circumstances often the least productive. And, most serious of all, the degenerate and positively vicious elements are allowed to poison the community with their tainted offspring, a miserable throng of individuals, who through no fault of their own enter life biased from their very cradle for evil and ineptitude.

And the remedy seems to be in a large measure in our own hands. We have spoken above of eugenics not only as a branch of science, but as a scientific creed. For Sir Francis Galton was not content with urging the mere study of the agencies which affect the racial qualities of future generations. In his mind was a mission, a purpose, that the principles brought to light by scientific study should be laid before the people and made the basis of a social code.

The eugenic laboratory founded and endowed by him at London University must in his mind have been destined not only as a scientific workshop, from which shall be turned out a collection of facts, but as the central organ from which shall be infused into the community a spirit of new wisdom, so educating popular opinion that a *mésalliance* offending the principles of eugenics shall come to be placed under the same taboo which in our day guards the bounds of social caste from similar inroads.

A great mind, a generous soul, a liberal hand—of these the world is bereft in the death of Sir Francis Galton. But his work remains, and shall bear fruit to generations yet unborn.

Wrecking a Bridge by Electricity

ONE of the most ingenious uses to which electricity was ever put was in the wrecking of a bridge over the Wabash in Indiana.

This bridge had been purchased by the county authorities, who intended to replace it by a steel structure erected on the old piers and abutments. The owner agreed to remove the bridge in thirty days. The task proved much greater than had been anticipated, but it was successfully accomplished.

The chief difficulty lay in the short time agreed upon for the removal of the bridge. Several wreckers to whom the matter was submitted declared that it would be impossible within thirty days to pull down the old bridge without injury to the piers.

The structure might be blown up with dynamite, but the explosion would also destroy the piers. Were it fired, the heat would crack and injure the masonry of the bridge. The thirty days expired, and an extension of one week was granted. The owner was at his wits' end, when he chanced upon an electrician who proposed, not to blow up the bridge, but to burn it apart. His proposal was gladly accepted. Each span of the bride was composed of nine chords of three timbers each. The twenty-seven sills were to be cut simultaneously, so that the span would drop between the piers into the river. The cutting was to be accomplished by burning through the wood with loops of iron resistance made red-hot by the passage of the electric current.

The job was begun. Fifty-four resistance loops were heated to wreck each span, and the spans were wrecked one at a time. Sufficient current was used to heat the iron wires cherry-red. The result was exactly the same with every span. Between the turning on of the current and the fall of the span an hour and forty minutes elapsed. Then the mass of timbers fell into the water well inside the piers, so that they were uninjured.

The cut made by the hot wire was sharp and clean, and the wood was not charred more than an inch from the place of fracture.

The whole operation took but a few hours. The current was first turned on at about five o'clock in the morning, and at two in the afternoon the last span crashed down to the river-bed.

Hydrocyanic Acid Gas Fumigation.

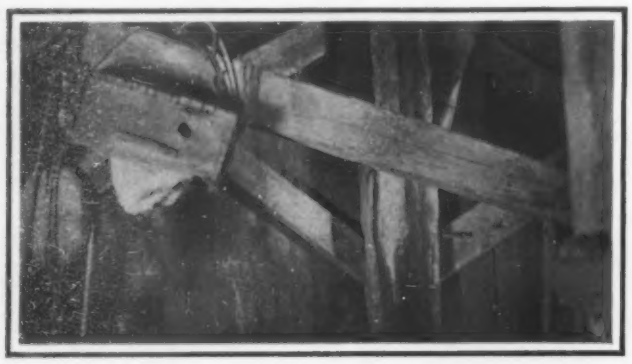
THE Bureau of Entomology has been of great service to the citrus fruit growers of California and Florida by investigating hydrocyanic acid gas fumigation. In the former State the work has been directed against the scale insects, while in Florida the efforts have been directed against the white fly. Much attention has been given to various spraying methods

A Nantucket Windmill of 1746 Still in Operation

How a Yankee Sailor Introduced the Dutch Windmill Into New England

By Allen Day

THE island of Nantucket is a miniature Holland in the number of its windmills. There are several types, ranging from old-time water lifters to the modern air motor, for there is not a creek or even a rivulet on the island, and the people must depend on rain falling on the roofs of their homes and collected in cisterns, or upon hand force pumps or air power for drawing water. Some of the more enterprising farmers have tanks at a height of forty to fifty feet above the ground supported by steel lattice towers. The ocean winds blowing over Nantucket create an air current which often blows at the rate of thirty miles an hour, and thus the underground water is pumped into the tanks. Piping extending to the ground, thence to the fields and gardens, forms a little irrigation area, while the force is enough to sprinkle lawns and flower beds and to furnish water for washing and other domestic purposes.



Stone brake by which speed of mill is increased and decreased by a box loaded with stone set on a controller beam and operated by a pulley.

Exterior view of mill, showing wings driven by wind and the spar which is actuated by the capstan.

The wings are not covered as mill has ceased operations temporarily.

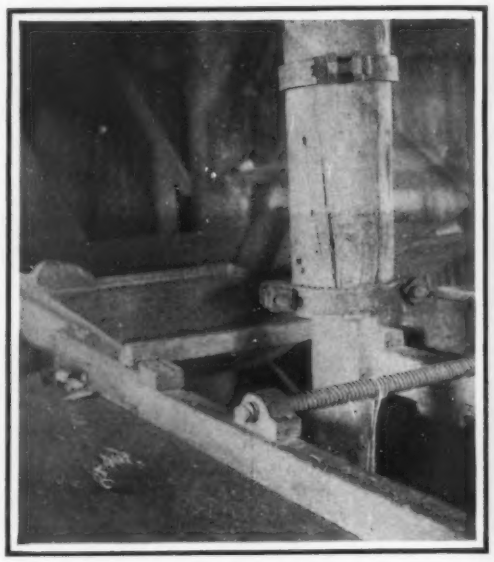
But the most interesting industry in Nantucket is a grain mill operated by wind assisted by "man power." It is the last of three that actually turned the corn—the only grain that will grow on the island—into meal. It is probably the oldest windmill in actual operation in America. It was completed in 1746, and with the exception of a few years, has been grinding corn since that time—165 years. The idea that the air current could be used for power for grinding grain occurred to Nathan Wilbur, a Nantucket sailor. He had visited Holland, which is wind-swept similar to Nantucket, and saw the canvas wings forced by the wind, sawing lumber, as well as converting grain into food products. When Wilbur told of his plan, the Nantucket people ridiculed it, but he was not discouraged, and decided to build the mill himself. On the island coast many shipwrecks have occurred. The oaken beams washed ashore furnished material for the framework, while deck planking of white oak, still as tough and firm as when pinned into the vessel, was available for the exterior.

One of the oddest features of this curious old mill is the way in which man aids the wind in its operation. While the air currents sweep over the island as steadily as over the sea, since it is 30 miles from the nearest shore, the breeze or the gale may continue from thirty-six to forty-eight hours without diminishing in force—enough to move the wings of the great wind wheel at full speed without the need of other power. But Wilbur thought of the days when the breeze was light, and when it might be necessary to run the mills continually to supply the demand for meal. His marine experience brought to his mind the idea of the capstan, which allows merely one man to exert a force that far excels his unaided strength. But the capstan was used for raising anchors, tightening ship cables—how could it be used for a corn mill?

Wilbur thought it over, and evolved a plan which was as ingenious as it proved to be practical. While, as stated, his neighbors had at first ridiculed the scheme of building the mill, they began to have more faith in him as they understood his plans more clearly. Then he told them that he could aid the wind in grinding by turning a spar attached to a capstan on the ground. With the help of teams of his neighbors, an old spruce mast among the wreckage that had drifted on the coast was hauled to the mill site. The upper end was fitted with a rim of hickory cog teeth, and the lower end set into the hub of a wheel. The cog end was fitted into the rim of what the railroad man would call the driving wheel, which moved the upper grindstone.

Wilbur cut and shaped the ship timber with a kit of tools brought from England. Piece by piece the framework rose from the ground. Its shape was octagonal. Nails were too expensive for fastening, and screws and bolts were unknown. So every part of the framework is held together by pins of hickory wood driven with a hammer through holes cut in the timbers. Although the mill from the roof to the ground is fifty feet high, Wilbur designed and constructed every part of it, except the grindstone shaft, and assembled the various parts. Only when he was ready to set the "machinery" and grindstones in place did he have help. The material for the upper portion was hauled up piece by piece by means of a rope and a pulley fastened to the top of a wooden beam set firmly in the ground. In this way he placed the pieces in position without other aid.

What the construction of this curious mill meant in time and labor may be realized when it is stated that the spar alone is 50 feet in length, 12 inches in diameter at the top, tapering to 6 inches where it is set into the wheel which is turned by the capstan. The four wings or arms of the wind wheel driven by the wind are each 30 feet in length, having a maximum width of 6 feet. They are covered with sail duck lashed to the framework with tarred cord running through brass eyelets in the cloth.

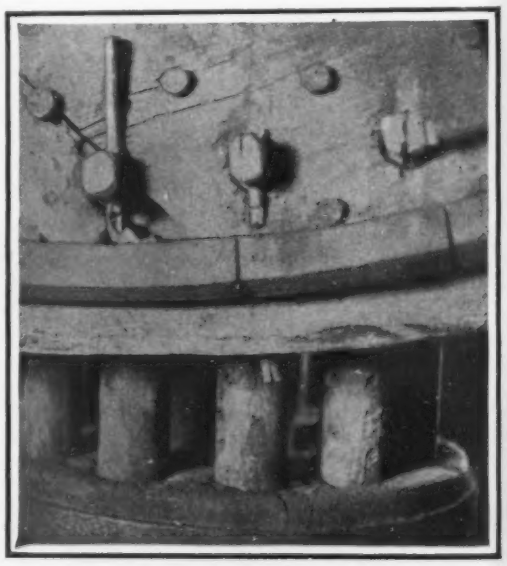


The shaft which is operated by the windmill.

It has never been repaired although in operation over 150 years. The shaft was cut out of oak, and all iron, including the shaft end that fits into the stones, was brought from Great Britain.

The interior mechanism of the mill is remarkable from an engineering standpoint. What might be termed a "driving wheel" is set in the top of the mill. It is also made entirely of oak. There are no spokes, as the wheel is solid, planks an inch in thickness extending from the hub to the rim. The rim itself is no less than a foot square in thickness, composed of sections cut into concave shape, so that the whole form a circle which is 11 feet in diameter. The sections of the rim are also held tightly by wooden pins, and the exterior of the rim is covered with a band of iron, taken from a wrecked ship. Projecting from the inside of the wheel rim are wooden cogs. These intersect another set of hickory "teeth" each three inches in length, which are wedged into the vertical shaft that revolves the upper grindstone. Consequently, as the driving wheel turns, it also turns the shaft. Such is the process that per-

(*Continued on page 99.*)



Interior of mill, showing stones for grinding corn; how they are turned by wooden cogs; also the rim of the great wooden wheel into which the cogs fit to cause the stones to turn.

Two Interesting New French Aeroplanes

The De Pishof and Paulhan Machines

THE DE PISHOF MONOPLANE.

THE new monoplane of Mons. De Pishof resembles in its general outline the No. XII. monoplane of Blériot, but it is a somewhat lighter and more powerful machine and it has a number of novel points. Above the two skids, which are suspended from the axle connecting the front wheels by means of rubber bands, there is a platform or frame containing the motor, radiator, and twin seats for the pilot and passenger. The single plane extends completely across the machine above the motor and aviator and carries a torpedo-shaped gasoline tank above it. It is suitably stayed above and below by the usual guys of steel cable and steel tape. The rear ends of the skids are extended back and upward to meet at their rear extremities downwardly inclined rods extending from a socket on the hub of the propeller (which in this case is placed back of the plane). On an upwardly-curved arm at the end of the frame thus formed is mounted a tail like that used on the Blériot monoplane. Below the frame are two small skids, one on each side. Twin vertical rudders are fitted above the tail, and a small but rather long horizontal fin extends from the center of the tail forward five or six feet. This machine differs from the Blériot XII. monoplane chiefly in having the propeller placed back of the plane instead of in front of it and also in the use of skids and framing resembling the Farman biplane. The motor is provided with a starting crank in front, and the use and arrangement of this and of the radiator gives the front of the machine almost the appearance of an automobile. The resemblance is further borne out by the use of a leather-lined cone clutch, which connects the motor with a shaft extending back nearly to the propeller. A sprocket at the rear end of this shaft drives another sprocket on the hub of the propeller by means of a chain. The propeller is of large diameter (9 feet) and it drives the machine at high speed (85 kilometers, or 52.8 miles an hour). The motor used is a four-cylinder Austrian Daimler motor of 60 to 70 horse-power. The possibility of starting this motor with the clutch thrown out, as in an automobile, is found advantageous when the machine descends in the open country and help is not obtainable. The control lever is placed at the right hand of the pilot and it operates the horizontal rudders and warping by fore-and-aft and by side motion respectively. Steering is accomplished by the feet. The dimensions of the monoplane surface are 3 by 9 meters (9.84 by 29.5 feet), and the supporting surface is 27 square meters (290.6 square feet). The over-all length is 9.5 meters (31.2 feet). The total weight of the monoplane complete is 360 kilogrammes (793.7 pounds). This is light compared with the Blériot, XII., which had an eight-cylinder V-type motor (the E. N. V.) of about the same horse-power as De Pishof's monoplane, but which was evidently a heavier engine. A description of the Blériot XII., and of Claude Grahame-White's experience in learning to fly it, will be found in SUPPLEMENT No. 1782.

THE NEW PAULHAN BIPLANE.

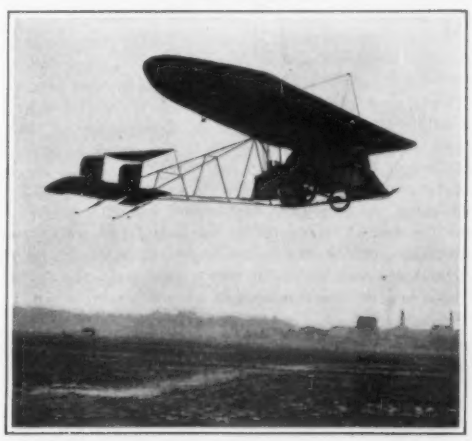
A short time ago we illustrated the hydro-aeroplane of M. Fabre. This machine was of novel construction, having wings with detachable cloth and ribs that could readily be taken apart and folded when not in use.

The Paulhan biplane, illustrated herewith, is constructed upon the same system as the monoplane of M. Fabre. The illustrations of this machine below give a good idea of its appearance and construction.

The main plan upon which this biplane is built is similar to that used by Glenn Curtiss with his biplanes. There is a central section containing the motor and aviator's seat, and the outer sections are attached to this central section in a novel manner.

The planes of the Paulhan machine are built upon a form of trussed girder made up of two long, thin,

The automobile-like De Pishof monoplane viewed from the front.



De Pishof's passenger-carrying monoplane in flight.

ash planks about 8 inches wide at their center part and ¼ inch thick. These planks are spaced about 8 inches apart and the lower one curves upward toward its ends until it meets the upper one. These two planks are tied together by flat steel plates forming a series of V's and thus giving a very rigid trussed girder that makes unnecessary the use of many guys. The ribs are attached to the lower members of these main girders by means of clamps passing over an armored wood fillet that lies within the base of every other V. The ribs are cut out of solid wood and are arched to the proper curve. The cloth is provided with pockets which enable it to be slipped on the ribs and laced in place. As the ribs are attached to the girders at their front ends only, they have a certain amount of spring or flexibility that, it is claimed, gives the machine automatic stability.

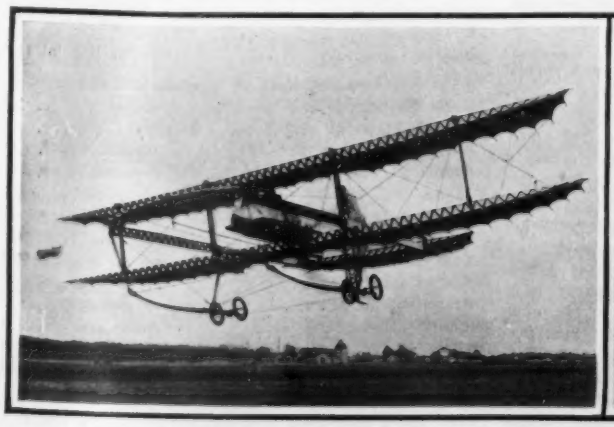
Both the upper and lower girders are divided into sections and connected by uprights. The uprights of adjoining sections are placed side by side and fastened together by S-shaped leather straps which wrap around them and are drawn taut by a special tightener. Leather straps are also used to connect the uprights of the center cell to the chassis as well as in most other parts of the machine where joints must be made. This use of leather for joints, it would seem, is a good idea, as leather is very tough and strong material. By using it the piercing of holes in the struts is rendered unnecessary.

There are two long trussed girders running from in front of the lower plane out to the rear, where they support the single-surface tail and the vertical rudder in front of it, while at the front they carry the monoplane horizontal rudder, or elevator. The motor is on a frame back of the pilot's seat, which is located in a torpedo-shaped aluminium car secured to the lower plane simply by crossed guy wires that run through it at the front. The car and frame are one and carry, besides the 50 horse-power Gnome motor, a large gasoline tank just back of the pilot's and passenger's seats, which are in tandem. The aluminium car is used to reduce air resistance and protect the aviator. The fore-and-aft girders have their sides covered with cloth in order to reduce air resistance. The machine is mounted upon two skids placed beneath these two girders, each skid being carried upon a pair of pneumatic-tired wheels connected together by a short axle which is attached to the skid by a rubber band and is guyed both fore and aft to keep it from twisting.

In place of the single control lever to which he has become accustomed in piloting the Farman machine, Paulhan makes use of a vertical steering wheel like that used by Curtiss. Pushing or pulling on this wheel turns the horizontal rudder downward or upward, while turning the wheel operates the vertical rudder at the rear. No warping of the wings or other device for correcting side tipping was shown on this machine when it was exhibited at the recent Paris show, and it is claimed that the flexible ribs in connection with the zig-zag girder construction (which resembles the cells of Dr. Bell's tetrahedral kites) give the machine sufficient transverse stability to make any of these devices unnecessary. One of the great claims for this new machine is the ease and rapidity with which it can be assembled or disassembled. The end cells may be detached by undoing three bolts at the top and bottom of the uprights—an operation which takes only a minute or two at the outside—and the whole machine can be taken apart and packed in a small case 15½ feet long by 3¼ feet square within an hour. The ready detachability of the end cells makes it possible to store the machine in an ordinary shed, as the total spread is 38 feet, which is reduced to 12 or 15 feet when the end cells are removed. The fore-and-aft length of this new biplane is 25½ feet, and including the horizontal rudder and the tail, the total lifting surface is 300 square feet. The weight of the machine is 800 pounds, which is not great considering its size and rather heavy construction. As the photograph shows, the Paulhan biplane appears to be an excellent flyer. Aviator Paulhan has opened a school at St. Cyr, and several pupils have already learned to fly this new machine.

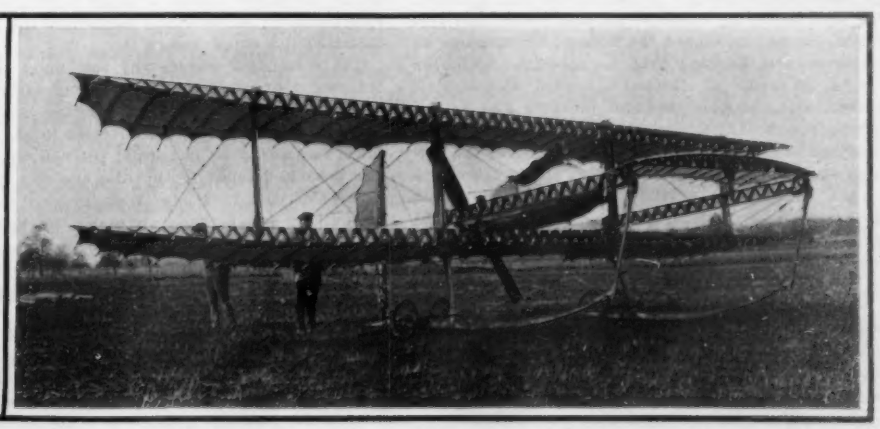
The chief advantages claimed by M. Fabre for his system are (1) great strength and rigidity; (2) small head resistance; (3) the non-use of trussing wires with their liability to loosen or break and with their considerable head resistance; (4) automatic trans-

(*Continued on page 99.*)



On account of the peculiar flexible construction of the wings, neither warping nor ailerons are required.

Paulhan in flight in his new biplane.



Paulhan is seated in the aluminium car and leaning forward. His padded aviator's helmet shows above one of the guys.

Three-quarter front view of the new Paulhan biplane.

THE NEW MACHINE BUILT FOR PAULHAN ON THE FABRE PRINCIPLE.

Correspondence

Cost of the Winton Car

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of January 14th, 1911, appears an illustration of our 1911 touring car. You have published the price of this car as $4,250. This price should be $3,000. THE WINTON MOTOR CAR COMPANY,

W. J. Ward, Advertising Department.

Cleveland, Ohio.

The Old Engineer Corps of the Navy

To the Editor of the SCIENTIFIC AMERICAN:

The report that reciprocating engines, and not turbines, are to be used on naval vessels may perhaps be accounted for on the theory that the jack-of-all-trades idea as to navy officers, introduced by the act of August 5th, 1882, and strengthened by the personnel act of 1899, is bearing its legitimate fruits in producing men of mediocre attainments as jacks-of-all-trades, but who might, on the theory of each man to his calling (special line where he excels), have given us great engineers, tacticians, gunnery officers, or whatever might have been the best in the man. I have, therefore, taken the trouble to ascertain what has become of the old engineer corps of the navy, including in my calculations only such as were graduated as cadet engineers, and who therefore were taught steam engineering as a sole profession. Of the 135 men so graduated at Annapolis, 35 were dead in 1908 (the date of my latest information as to the old engineers), 27 were on the retired list of the navy, 36 had resigned from the navy to enter civil callings, and 37 were on the active list of the navy. Assuming that the men who stand highest in their classes are, on the whole, the men best qualified for their calling, and confining the count to the highest five men in each class (one class has but three members), the count shows 11 dead, 4 retired, 15 resignations, and 13 still in the service on the active list. Those counted as resignations were all alive in 1908 in each case. U. S. N. A. (Line).

Death in Too Steep a Descent

To the Editor of the SCIENTIFIC AMERICAN:

The recent sad fatalities to my friends Mr. Arch. Hoxsey and Mr. Ralph Johnstone prompts me to address you in view of giving my opinion as to their cause, especially in view of the fact no theory has been advanced among the skilled in the science of aerodynamics that locates convincingly the direct cause of these disasters, to say nothing of that which befell Mr. Moisant and some others before him.

An aeroplane in flight, with its nose dipped toward the earth, at an inclination at which it no longer retains an angle of incidence toward the line of descent, and wherein the center of pressure is entirely gone from under the main plane, eventually—by gravity—develops such terrific speed that it becomes impossible to again right the machine; the small area of surface on the horizontal control being inadequate to counteract the tremendous pressure now exerting its full force upon greater area of exposed surface, namely, that running along the main plane on top, near its leading edge.

I am of the opinion the extremely daring aviator, desiring to execute a sensational, rapid glide toward the earth while in flight, or while performing a spiral dip, likewise the aviator who makes too quick a landing, unconsciously allow the center of pressure under the planes to remain at zero for far too long a period. For, after executing either of the above-mentioned performances, he has dipped the nose of his machine so steeply toward the earth that the aeroplane no longer retains an angle of incidence toward the line of descent, and the great head-on pressure due to the terrific speed the forces of gravity have brought about, is now directed against and on top of the forward edge of the main plane. This air pressure acts against and on top of the parabola of the curved surface of the plane situated immediately back of the leading edge. Eventually the pilot pulls at his levers in an endeavor to bring the machine to an even keel, only to find that the area of surface on the horizontal control is now insufficient to counteract the head-on pressure directed against the top edge of the main plane. The latter offers an area of surface to this head-on pressure many times in excess of that possessed by the horizontal control, and so the aviator is entrapped to his doom.

As it is not considered practical, by many, to increase the surface of the horizontal control, may I suggest the advisability of encouraging inventors to produce a safety stop, to be put in use on the control levers of aeroplanes, that will prevent flying up or down beyond a certain safe angle.

New York, N. Y. JOSEPH W. CURZON.

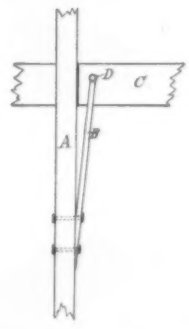
Wood Bending in Nature.

To the Editor of the SCIENTIFIC AMERICAN:

In the November 12th, 1910, issue of the SCIENTIFIC AMERICAN you state that the chief objection to the use of wing warping in aeroplanes is that the spars are weakened by the constant bending. I have read several articles to the same effect in current aeronautical journals.

A good instance of the abuse which a good piece of wood will stand without distress is found in our raisin-stemming plants. Below I show diagram of a part of a raisin grader.

A is a stationary post, *B* a hickory strip, ¾ by 4 inches, bolted solid at bottom to post and fitted with a pivot joint at *D*, upon which shuffling box *C* weighing 250 pounds is mounted. The box *C*, and consequently the upper end of *B*, move back and forth a distance of 4 inches at 300 strokes per minute. Thus a length of 30-inch *B* is flexed back and forth 2 inches each side of normal position. These machines



are run continuously for ten or more hours per day for about two months each year, and the strips *B* last for years. It would be impossible to subject an aeroplane spar to the abuse which these sticks stand without distress, and so it would seem that the injury in the case of the former was greatly exaggerated.

Bostonia, Cal. DONALD H. GORDON.

The Mirror Problem

To the Editor of the SCIENTIFIC AMERICAN:

The "Mirror Problem" submitted by Mr. Carl Herring, of Philadelphia, Pa., and published in your issue of December 24th, 1910, contains nothing of mystery whatever, and should offer no difficulty to one who gives it a moment's consideration. The question, "Why does a mirror reverse right and left, and not up and down?" is, in fact, a false statement of the proposition; for while the mirror does not actually reverse either horizontally or vertically, it does reverse vertically just as much as it does horizontally. The mirror shows only such reversal as has already been given to the object reflected. In placing a book before a mirror, the page is of necessity reversed from the position in which it may be read by the eye, and the appearance of the reading matter in the mirror depends wholly upon the manner of the reversal. If the book has been turned side for side, then the reversal will be from right to left, but if the reversal has been top for bottom, then the letters will appear in their usual order, but upside down. The apparent reversal by the mirror depends upon the fact that it really does nothing of the sort, but gives back just what it receives. That this is true may be made very apparent if printing upon a transparent sheet be held before the mirror, when, whether normal or reversed, it will readily be seen how accurately the image conforms to the object before it.

The reason, of course, why the image in a corner between the two mirrors does not appear reversed, is that it is a secondary image, reflected from the other mirror, and because it was reversed in the first glass, must necessarily be in normal position when given to the second, because in this the eye sees it from the other side.

Another, and perhaps an easier, method for some to understand, of explaining this matter, is through its analogy to the process of printing from types. When the type comes in contact with the paper, it is easily understood that the image which it leaves must be identical with that of the face of the type, yet when we look at the type itself, it appears in reverse. The reason of this is that we see the type from the wrong side. If the type body were transparent, and we should look down through it to the face of the type in the act of printing, the letters would appear normal; but when we lift the type and reverse it so as to look directly at the printing surface, then the letters naturally take the reverse position. It is all a question of which side we look at the object from, both in the printing and the image in the mirror; for in holding a printed page up before a mirror, we have already reversed the position, and as the mirror gives back exactly what it receives, we get exactly the same view of the printing as if we looked at it through the back of the sheet.

Mount Carmel, Ill. D. E. KEEN.

[We have received a flood of interesting replies to the Mirror Problem, but lack of space prevents us from publishing more than one of them.—ED.]

Relative Strength of the World's Navies in Armored Ships

To the Editor of the SCIENTIFIC AMERICAN:

The annual statement from Washington giving the standing of the world's navies appeared recently in the newspapers placing the United States in second place; and almost at the same time there was published a dispatch from Berlin which stated that the United States would not be in second place if the obsolete vessels had been left out of the standing. In the first place, both tables were reckoned according to tonnage, which is very misleading, as a nation's naval strength depends entirely on her armored ships. While it is true that Germany will be in second place in a year or two, due to her greater activity in building dreadnoughts, she is not in that place now, as the following table will show. Germany, in her anxiety to throw out the obsolete American battleships, forgot that she as well as other nations has old ships contemporary with ours which also must be left out. To make this clear, I have separated the column under "battleships" into "modern" and "old," as well as the dreadnought column into "dreadnought battleships" and "dreadnought cruisers." Thus it will be seen that while Germany apparently surpasses the United States in dreadnoughts, i. e., 17 to 10, such is not the case at the present time, each nation having but four in commission. On the other hand, the superiority of the United States in "modern" battleships is evident; and what is more to the point, Germany has one more "old" battleship than the United States.

THE WORLD'S NAVIES, BUILT OR BUILDING, 1911.

Country.	Number of Dreadnoughts.		Number of Battleships.		Number of Cruisers Armored.
	Battleships	Cruisers.	Modern.	Old.	
Great Britain	15	5	40	11	34
United States	10	0	16	9	15†
Germany	13	4	16	10	9
France	8*	0	13	5	16
Japan	5	2	10	1	13
Russia	4	0	10	5	8
Italy	4	0	10	0	11
Austria	4	0	6	0	4
Argentina	3	0	0	0	0
Brazil	3	0	0	0	0
Spain	2	0	0	0	0

* Including 6 "Dantons," as per the foreign statistics.
† Including 3 "Charlestons," as per the foreign statistics.

The "old" battleships of each country in the above table and the total number of armored ships are as follows:

	Class
Great Britain	"Canopus"
	"Renown"
	"Swiftsure"
United States	"Alabama"
	"Kentucky"
	"Iowa"
	"Indiana"
Germany	"Mecklenburg"
	"Kaiser Wilhelm II."
France	"Brennus"
	"Gaulois"
Japan	"Tango"
	"Sinope"
Russia	"Imperor Nikolai II."

TOTAL NUMBER OF ARMORED SHIPS.

Great Britain	105
United States	50
Germany	46
France	42
Japan	31
Russian	27
Italy	27
Austria	14
Argentina	3
Brazil	3
Spain	2
Grand total	350

By the above list it will also be seen that even a year and a half from now the United States will surpass Germany in total armored ships by four, but her superiority in dreadnoughts will, of course, land Germany securely in second place.

Brooklyn, N. Y. HAROLD M. KENNARD.

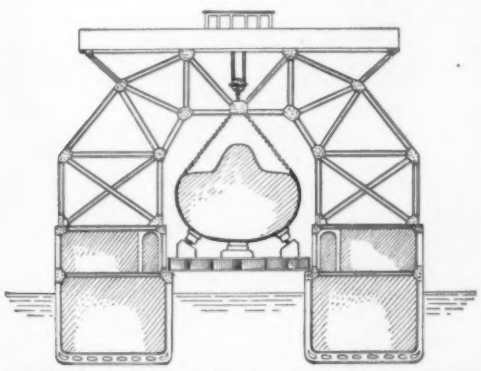
The Rescue of a Sunken German Submarine

How the "U.3" was Raised by a Special Floating Dock Built for that Purpose

ALTHOUGH submarine navigation is admittedly dangerous, it will come with a shock of surprise to many people to learn that during the past ten years, according to recently published statistics, the lives of 129 officers and men have been lost in some twenty serious accidents which have occurred, all of them during peace maneuvers. Most of these fatalities might have been prevented had there been at hand, or within reasonable distance, the proper appliances for quickly locating the sunken vessel and raising her to the surface. It was only in connection with the latest accident, which occurred to a German submarine, that a suitable salvage plant was available; and it proved its efficiency by raising the vessel within three hours after reaching the scene of the disaster.

Of the submarine accidents above referred to, seven occurred in the French navy, with a loss of 54 lives; five in the English navy, with a loss of 28 lives; two occurred to Russian submarines, with a loss of 21 lives; one Japanese accident occasioned the loss of 14 lives; Italy in one accident lost 8 men; and the United States in four accidents has been so fortunate as to lose no lives.

The speedy raising of the German submarine "U.3," which sank in the harbor at Kiel, was due to the possession by the Germans of a sea-going, salvage dock, capable of navigating under its own steam, which was built expressly for the raising and docking of sunken submarines. This vessel, the "Vulcan," which is shown on our front page in the act of raising the "U.3," is a double-hull vessel, 230 feet in length, with a lifting capacity of 500 tons. The width between the two hulls is sufficient to admit with good clearance the largest submarines. At a suitable height a shelf is formed along each wall of the interior opening, and upon this rests the removable floor of the dock. The two hulls of the ship are each built with watertight compartments of large capacity, similar to those which are found in the side walls of the ordinary floating dock. When a sunken submarine is to be raised, the "Vulcan" steams to the wreck, and is moored securely in position above it. Spanning the well between the two hulls are two massive gantry cranes, each provided with heavy lifting tackle driven by electric motors. The first operation is to fill the compartments until the vessel has sunk to the required depth. The floor of the dock is then moved clear of the well. The lifting tackles are now lowered and made fast, either to chains which have been slung around the body of the submarine, or to two massive eye-bolts which are permanently riveted into the submarine's hull. At the order to hoist away, the submarine is lifted free from the mud and drawn up within the well, until its bottom is clear of the supporting shelves on the inner faces of the two hulls, above referred to. The dock floor is then placed in position upon the shelves; the water is pumped out of the two hulls, and the "Vulcan" rises, lifting the submarine and the dock floor clear of the water.



Cross-section of the "Vulcan," showing a submarine lifted by the gantry crane and placed upon the removable floor of the dock.

There is some confusion in the accounts which have been cabled over regarding the loss and salvage of submarine "U.3." As soon as the accident occurred, the crew released a spherical buoy containing telephone apparatus, which rose to the surface, uncoiling its wires, the lower ends of which were attached to the hull and led to a telephone within the vessel. By this means the captain of the "U.3" was able to communicate with the surface; and he reported that the vessel had a forty-eight hours' supply of oxygen, and that the crew were in no immediate danger. Orders were at once dispatched for the "Vulcan" to proceed to the scene of the disaster. According to one report, a floating crane, pending the arrival of the "Vulcan," succeeded in lifting the bow of the submarine sufficiently for twenty-seven of the crew to escape through the torpedo discharge tube, the captain and two lieutenants electing to remain in the conning tower until the arrival of the "Vulcan." The breaking of a ventilator, however, and the subsequent flooding of the vessel, unfortunately proved fatal to the three officers. On the arrival of the "Vulcan," she was moored above the wreck, and in three hours' time the vessel appeared above the surface.

The "U.3" was built at Danzig in 1909. She displaces 300 tons, and is of the submersible, as against the true submarine type. The hull proper is circular in cross section; but she is provided with a deck which extends the full width of the vessel and is rounded down to connect with the circular shell. An end-on view of these vessels, therefore, gives them a flattened U-section. In November last, in company with submarine "U.4," the "U.3" made the passage from Cuxhaven around the Skaw to Kiel, a distance of 540 miles, in about forty hours, the journey being made without any convoy.

Climatological Returns from the British Colonies

THE English Meteorological Office has earned the gratitude of meteorologists, climatologists, geographers, and medical men by undertaking to place at the disposal of the scientific world the meteorological observations made in the British crown colonies and protectorates, which have heretofore been merely filed in manuscript at the Meteorological Office, or published in a most inadequate form in the Blue Books of the Colonial Office. Information concerning the climate of these colonies—a most important matter to prospective settlers—has been extremely difficult of access.

In 1907 the director of the Meteorological Office prepared instructions as to organizing and publishing meteorological observations, and these were widely circulated in the colonies in question, through the Colonial Office. The form of publication in the Blue Books has been much improved in consequence, and arrangements have now been made to print off additional copies of these meteorological records, which the Meteorological Office will distribute to appropriate scientific institutions throughout the world. The Office will also publish and distribute summaries of the meteorological returns that it receives in manuscript from many distant parts of the world.

Among the places from which data are available are: Gibraltar, Cape Spartel, Falkland Islands, St. Helena, South Georgia, Suva (Fiji), Fanning Island, Malden Island, and Ocean Island.

Forest and Field as Hospitals

IN general the treatment of disease among primitive races resembles the healing by prayer and faith, and other superstitious practices, which are not unknown in civilized countries, but most savages improve upon our miraculous healers by isolating the patient. Experience has taught them the danger of infection, but the isolation of the patient is prompted, not by this danger, but by the belief that the sufferer is possessed by a demon, as certain European sects still believe to be the case with the insane. Various methods of expelling the demon are practised. One is especially interesting because of its resemblance to a method, mentioned in the Bible and practised by our forefathers, which is always erroneously interpreted. Diseased persons were placed outside the gates of the city, not to prevent infection, which was rather promoted by placing the patient exactly where traffic was most congested, but to facilitate cure by the patron deities which, in all popular beliefs, sit at the gate of the house, the city, or the state. In central Sumatra lepers are driven from the village to a forest, "to beseech the gods of mountain and forest to cure them." In many districts huts are built in the forest for the sufferers. The natives of the island of Nias, in epidemics, compel the sick to go out into an open field, where a shed is erected to shelter them.

The Current Supplement

THE current SUPPLEMENT, No. 1830, opens with an article by Prof. Joseph W. Richards, entitled "What Electrochemistry is Accomplishing."—Many inventors have devoted time and brain work to the perfection of means for manufacturing rolled beams, and of later years, more particularly to the manufacture of so-called "H" beams. Mr. G. E. Moore reviews recent practice followed in the manufacture of these rolled "H" beams.—Some excellent formulæ are given for obtaining various zinc finishes.—An interesting Mexican forest railway is described by Mr. A. Reiche.—Sir Joseph J. Thompson's presidental address to the Junior Institution of Engineers, dealing with the relation of pure science to engineering, is summarized.—An analysis of Joseph's Brucker's scheme for crossing the Atlantic in an airship is presented.—Very curious and singularly interesting are the comparatively little known details of the origin and progress of the rite of deification or consecration, which at one time obtained so extensively for the Caesars. Mr. P. F. Mottelay discusses this rite on the basis of some recent discoveries that have been made by one of the prominent members of the French Academy of Sciences.

Mimicry with the Mimic Left Out

By Benjamin C. Gruenberg

THE doctrine of "natural selection," particularly as it has been applied by some of its friends in the interpretation of certain special phenomena of nature, is receiving a great deal of adverse criticism —not only from experimental botanists and zoologists, but also from competent field naturalists. The theory of "Mimicry" has supplied material for much controversy; but until recent years most of this has been of a speculative character, since there had not been gathered enough facts to warrant any conclusions one way or the other. The theory itself is fascinating enough, and has been quite satisfactory to the uncritical lovers of nature.

There are known many cases of truly remarkable resemblance between species of animals belonging to totally different families. The most common example in this country is that of the resemblance between the "Monarch" butterfly and the "Viceroy." This curious relation was first pointed out by Bates, from his studies in tropical America; it was independently discovered by Wallace in tropical Asia and in the Malay archipelago, and since observed by many students in all parts of the world. Wallace has given the best statement of the general facts, which are essentially as follows:

1. The two species always occupy the same area and inhabit the same kind of stations.

2. One of the two (the "mimic") is always more defenseless than the other.

3. The mimic is always less numerous than the mimicked species.

4. The mimics differ considerably from the bulk of the species in their own family.

5. The resemblance is always superficial, and extends only to such characters as are concerned with the general appearance. Under these conditions it is very easy to believe that the more defenseless species derives certain advantages, in the sense of protection against common enemies, from its resemblance to the better-defined species. And according to the doctrine of natural selection, if applied to these resemblances, the resemblance is the result of the gradual elimination of those individuals among the ancestors of the "mimic" group who least resembled the "models."

The most recent contribution to a knowledge of the actual facts is that of R. C. Punnett, Professor of Biology at Cambridge University, who spent the summer of 1909 in the island of Ceylon making a special study of the whole problem. In Ceylon there are many good examples of "mimicry," and the conditions for study were very favorable.

Prof. Punnett found that the "models," which are supposed to derive their superior protection from a combination of unpalatability and distinctive coloration, have not the identical distribution of the "mimics," which are supposed to derive their protection from their resemblance to the models; at most the areas of distribution overlap. The common birds, which are supposed to be the agents of natural selection in the elimination of those forms that did not sufficiently resemble the model, are found rarely to attack *any* of the butterflies. On the other hand, the common lizards are very voracious, and destroy large numbers of butterflies as well as of other insects; but by actual experiment it was found that the lizards make absolutely no discrimination between the supposedly "unpalatable" forms and the supposedly "unprotected" relatives of the mimics. The failure to discriminate was also observed in the only other serious enemy of these insects—a certain fly that attacks the butterflies, pierces the thorax

(*Continued on page 99.*)

Equilibrium and Rest Positions

The Mechanics of Keeping One's Balance and Being Comfortable

By A. A. Somerville

FROM the standpoint of mechanics alone, and aside from physiological reasons, a man is ordinarily in the most comfortable position when he is in the most stable equilibrium and for physiological reasons when most relaxed. Comfort in its relation to equilibrium implies liability to avoid falling. A body is probably in the most stable equilibrium when its height is a minimum, the area of its base a maximum, and a vertical line drawn from the center of the mass passes through the center of the base. Reasoning from this definition would lead to the conclusion that a man lying on his back with limbs spread would comply with the conditions, and this is not infrequently the case of position for extreme relaxation. This brings out another idea, and that is that one rests only when the muscles are relaxed. Part of the body may be rested at a time. Such is the condition when one sits down in a chair. Such is also the case when one stands, bearing most of the weight of the body on one limb. Such a position also complies fairly well with the definition of stable equilibrium, which is the principal thing to be established in this article. For this purpose, several photographs have been made especially to fit the case, and others have been picked up that fill in admirably well.

To begin with, standing in a rest position betokens sociability rather than business. To this any military officer will testify. Possibly it has been fixed by custom, but more likely by efficiency. The most common illustration possible, that of a uniformed cadet at "Attention" and "At Rest," shows the idea. In the first case he is ready to "go." Here there is practically no relaxation whatever—all muscles tense; also perfectly erect, which implies that the center of gravity line falls directly between the feet or center of the base.

In the second position, "At Rest," most of the weight is thrown on one foot, the one in the rear, the other foot thrust forward, the body thrown only slightly forward, and the center of gravity line falling within or very near the rear foot. A special picture has been made to show this by hanging a plumb line directly in front of a man so posed. The limb placed forward is almost wholly relaxed. However, if this position is held very long, it becomes uncomfortable. It has been suggested that this position of rest is typified in the case of a tent pole and guy rope—one supports the weight, and the other is thrown around in any direction to balance any forces that may suddenly appear.

Note the case of a civilian (Fig. 4) in a place where he is not free to sit down, but leans instead, and he really forms a tripod. When tired one frequently makes use of this third support. An aged person may use a cane, and not be lame in either limb, but the cane is used as a prop, and so enlarges the base of the supporting body. In this case it is not for resting, but rather for stability, which indirectly leads to comfort.

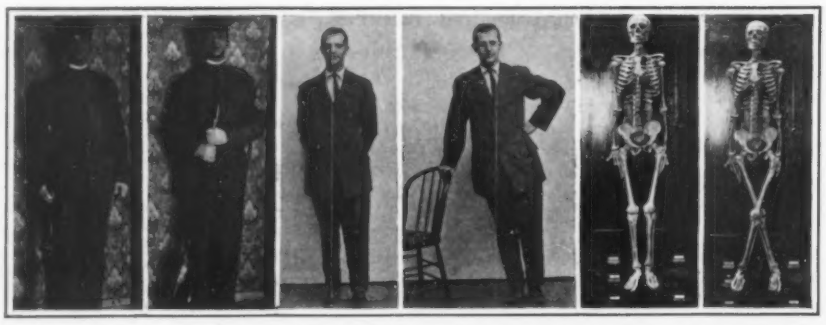
Another habit which is restful in itself is that of leaning on a desk when writing, and also when eating, if the latter were only permissible in polite society. This is a case of making the elbows or arms support part of the body, or really broadening the base of support.

In reality, when one is standing erect, his form is very much like that of a top standing on a point. Fig. 5 shows that the base is really very small. The statement has also been made that by crossing the limbs at the knees, as one sometimes does when not putting up a very dignified appearance, a so-called lock is formed within the hip bones tending toward greater stability. The latter end is possibly attainable, but not by any interlocking of the bones, as the pictures probably show. But, due to the X or cross formed, if one tips either to the right or left, the center of mass of the body is lifted, which is contrary to the law of gravity, and there is a tendency to settle back to a stable position.

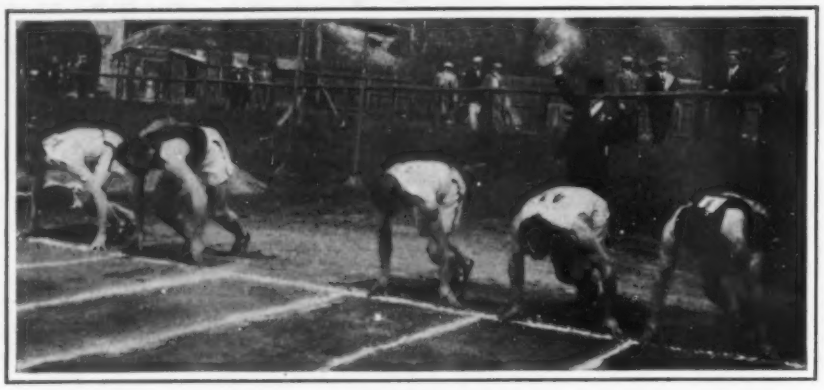
When a person expects a playful onslaught or attack, he braces himself or becomes more stable by placing the feet farther apart—note the common picture of the center on a football team in action. Sometimes for greater stability or for a stronger brace the hands are placed on the knees to stiffen the body, the action being the same as that of resting the arms upon the table.

This is carried to a still greater extreme by a man in a football line, where he crouches so low as to get both hands on the ground, and so has a minimum height and maximum base. The constant training a football line receives is to get low.

The track man starts from a crouching position, but this is for the purpose of preserving kinetic or moving rather than static equilibrium, for when crouched the body may be pushed ahead, while due to its inertia one would topple over backward if he attempted to start running while in an upright position. After once started, however, the body may gradually be brought to a more nearly upright position, and now due to its own inertia it will be kept moving.



1. Position at attention. 2. Position at rest. 3. Plumb line on one foot. 4. Leaning against a chair. 5. No arch here. 6. With legs crossed.



7. A crouching start.

EQUILIBRIUM AND REST POSITIONS

This crouching position is well shown in Fig. 7. The picture was made at a regular track meet, and was caught at such a time that the smoke of the starter's pistol is seen while the runners have not yet left their positions.

A different motion is brought out in the case of throwing. When a baseball player throws a ball, a twisting motion is used, what in mechanics is called a torque. He bears all the weight on one foot, and uses that foot as a pivot about which he swings, using the other foot and limb as a lever to push himself around. It is much on the same principle as swinging a stone in a sling, except that without the sling the man simply pushes himself part way around by taking a step forward and around the other foot upon which he is standing.

Things to be noted then are these: One unconsciously assumes a rest position; this is when most relaxed and most stable. To withstand an attack, the muscles become tense and the base broadened, that is, both feet are made to support the body. This latter is easiest noted by "attacking" a man or surprising him. If one is suddenly stopped by someone else when he least expects to be interrupted, he momentarily braces himself and assumes a position akin to that for defense. He then gradually shifts the weight to one foot, and rests while he is being detained. The length of time during which the suspense continues depends entirely on the extent of the surprise or the lack of ease which is felt, which, of course is greater among strangers than friends.

Metals More Precious than Gold

INASMUCH as it is the standard of currency, most persons seem to think that gold is the most precious of all the metals. This, however, is a mistaken notion. Indeed, the number of metals which, at the present time, are more valuable than gold, exceeds the number of those that are of less value.

The cheapest, but not the most plentiful of metals, is iron. In its class are lead, zinc, copper, arsenic, tin, mercury, aluminium, and nickel. In the next class, with reference to gold, we find antimony, cadmium, sodium, and bismuth. A sharp rise in the scale of prices intervenes between this class and the next approaching that of gold, i. e., that comprising magnesium, manganese, tungsten, silver, thalium, and molybdenum, all of which are sold by the ounce, the prices varying quite a good deal. Then, in a class by itself, so to speak, comes chromium, a metal whose ores occur somewhat abundantly in the Shetland Islands, but which is difficult to procure in the free state.

At this point enters gold.

Of the metals more precious than gold, there should first be mentioned that peculiar one known as platinum, found in California, Canada, Brazil, Australia, on the slopes of the Ural Mountains, and elsewhere. Platinum is said to be really an alloy of the metals platinum, palladium, iridium, osmium, rhodium, and ruthenium, together with a little gold and iron. All these, save the last, are "noble" metals. They do not tarnish in the air, and are not soluble in any single acid.

The most plentiful metal occurring in native platinum is that from which it takes its name. This is of a grayish color, and, with one exception, is the heaviest substance known. Its fusing point is extremely high, and this property, together with its freedom from tarnish, renders it available for the manufacture of crucibles and other vessels required by scientists to withstand a very high temperature. It is also sometimes used as a substitute for gold in photography; and when deposited in a thin film on the interior of the tubes of telescopes, it forms a dead-black surface that prevents the light from being reflected by the polished sides. The demand for platinum largely exceeds the supply; hence the metal is ever advancing in price.

Palladium is of a lustrous white color. It is the most easily fused of the metals found in platinum ore, and can even be volatilized. A curious quality of this metal is that, when heated to redness, it is porous to hydrogen gas, allowing it to pass through somewhat in the same manner that blotting-paper permits the passage of water. The silvery-white color of palladium and its freedom from tarnishing render it useful for making scales and division marks on scientific instruments. A mixture of this metal with mercury is sometimes used in dentistry.

Osmium is a metal that possesses two remarkable properties. In the first place, it is the most refractory of the metals, resisting fusion at the most intense heat. It is also the heaviest of the substances, being almost twenty-two and one-half times heavier than water. Together with iridium, it occurs principally in a peculiar variety of native platinum called osmiridium. This mineral differs from ordinary platinum ore in that it contains a larger proportion of osmium and iridium than platinum. Osmiridium is found in small particles varying in weight from one-sixth to one-third of a grain. These particles are extremely

(*Continued on page 100.*)

Some Typical Groups of American Aborigines

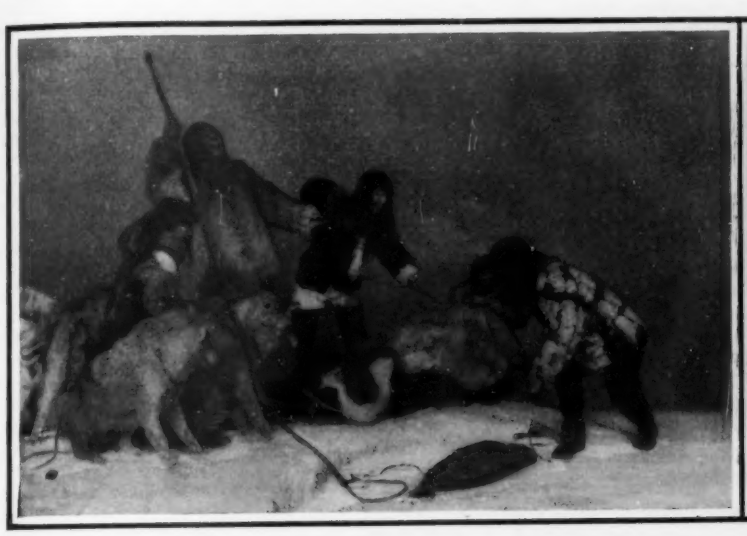
Scenes of Life and Customs Among the Natives of Our Hemisphere

By Randolph I. Geare

THE present article is intended to convey briefly an idea of the appearance and chief characteristics of typical representatives of several of the most prominent stocks of American Indians.

The Eskimos of Smith Sound, northwestern Greenland, are the most northern inhabitants of the world. Bands of these people winter as far north as latitude 79 degrees, and they have summer camps as high as 82 degrees. The name "Eskimo" is said to mean "eaters of raw flesh." We all know in a general way what the Eskimos look like. They are of medium

(*Continued on page 100.*)



Eskimo family at Smith Sound in merriment at preparing to haul home a small seal.

Sioux family group.—Man returning from the chase, girl beading a moccasin, and woman dressing a hide.

Western Eskimos.

Woman in center clad in caribou skins; one to right in marmot skins; the man is dressed in caribou skins and holds a barbed harpoon.

Mexican and South American Indians.

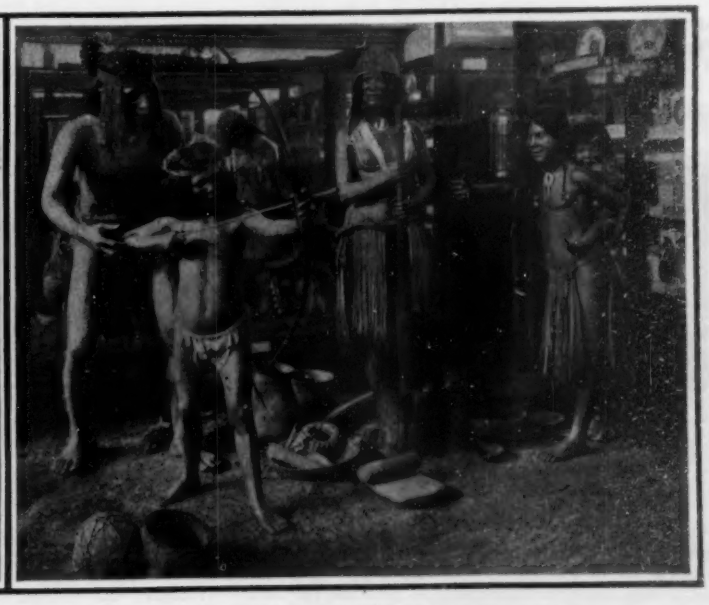
On the left a Jivaro Indian; in center an Oaxaca woman; on the right a Piro Indian.

Maya-Quiche Indians of Guatemala.

Once the most highly cultured of all nations of western hemisphere. a family group.

Tehuelche Indians of Patagonia.

They dress in skins of animals, make tents of hides and live on animal food. They are tall and athletic.



Cocopa group of Mexican Indians of Sonoran province.

Young man teaching boy to shoot, woman pounding corn, and girl carrying baby.

TYPICAL GROUPS OF AMERICAN ABORIGINES

Science in the Current Periodicals

In this Department the Reader will find Brief Abstracts of Interesting Articles Appearing in Contemporary Periodicals at Home and Abroad

A New Camera with "Full-Sight" View Finder

WHILE cameras with fixed focus, or with a focusing scale, are popular with amateurs for work in which no very high standard of perfection is sought or attained, it is generally admitted that the best results can be secured only by the use of a ground glass focusing screen, on which the view to be photographed can be seen in full and focused by direct inspection of the image upon the screen. The use of this arrangement, however, brings with it an obvious disadvantage. It necessitates a series of steps such as focusing, moving the focusing screen away so as to admit the plate carrier, inserting the latter, setting the shutter, opening the plate carrier, and only then is the camera ready for exposure. In many instances, especially in landscape work, the delay incident upon these operations is of no particular consequence. But on the other hand, quite often it is indispensable to have the camera in readiness to make the exposure at a moment's notice, and in such cases a camera working on the usual direct focusing principle is inconvenient or even useless. Cameras have been constructed in which the image formed by the lens was cast, by means of a mirror set at an angle within the camera, upon a ground glass screen placed horizontally in the top of the camera. Cameras of this type, however, have a number of disadvantages. They are voluminous, expensive, and, in use, must be held sufficiently low to enable the operator to look down on the focusing screen. The result of this last feature is an undesirable and unnatural perspective. There was, therefore, scope for the invention of an improved camera, which should offer the advantages of direct vision focusing, while avoiding the shortcomings of the mirror camera. An apparatus which seems to fulfill the necessary conditions is described by F. W. Oelze, in *Die Umschau*, and is presented in our accompanying illustrations. It will be seen that the camera, when folded up, occupies but a small volume. On the right hand side there is a slit *S*, into which the plate holder is inserted. The milled head *V* is then turned, whereby the plate holder is held fast in place. The body of the plate holder is then simply pulled out, leaving the plate, held in light frame, in the camera. The plate is next lifted up out of the field of the lens by two turns of the milled head. At the same time the focusing screen automatically advances into the place previously occupied by the plate, so that the view becomes visible upon the ground glass, the light being screened off by the shade *L*.

The adjustment of the focus is most conveniently effected by adjusting the position of the base strips *D*, upon which the lens holder is mounted, this motion being effected by means of the fore finger as indicated at *E*, applied to a projection situated at a suitable point. After thus setting the focus, which can be done very rapidly, the camera is ready for making the exposure by pressing the knob *A*, shown in Fig. 2. This actuates the shutter, pushes back the focusing screen and exposes the plate.

The camera has a number of additional new features, of which one may be mentioned, which consists of a safety device, preventing any possibility of exposing the same plate twice. Another interesting device is an arrangement whereby the camera ordinarily sets itself automatically in position for focusing (infinitely) distant objects, that is to say, in the position corresponding to the "fixed focus." To give an idea of the extreme applicability of this new camera, it may be stated that it has been successfully used even for such difficult cases as the photographing of fish under water. In the interest of persons who are already possessors of other cameras, and who may wish to avail themselves of the advantages of this new invention, it may be mentioned that the essential parts can also be obtained separately in such form as to be adaptable to an existing camera. The advantages of this new departure in the field of photography seem to commend themselves both to the amateur and the professional photographer, and it would seem that there should be quite a demand for cameras equipped with this "full-sight" view finder and focusing screen.

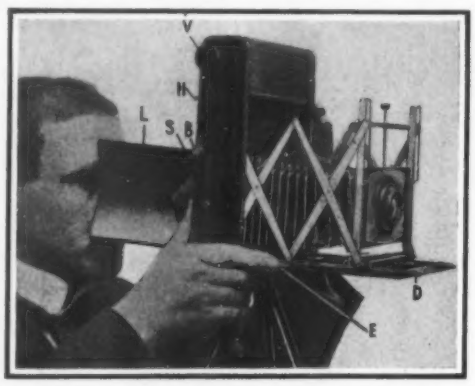


Fig. 1.—Front view, showing manner of focusing with index finger.

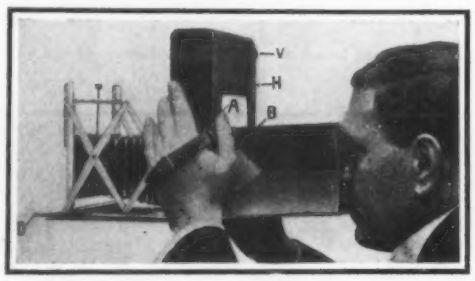


Fig. 2.—Rear view, displaying focusing screen.

NEW CAMERA WITH FULL-SIGHT VIEW FINDER AND FOCUSING SCREEN

The Right and the Left Face

IT is at the present day well known even to the layman that various functions of the brain are localized at definite points. This may become evident, for example, if a particular portion of the brain becomes affected by disease, accident, or under the knife of the operating surgeon or the experimental physiologist. Some extraordinary derangements of the mind may arise in this way. Thus in certain diseased conditions a person may lose his power of speech, though fully retaining his understanding and the control of the muscular mechanism involved in articulating. He has simply lost his "word-sense," and is suffering from what the physician calls "motor aphasia." Injury to another brain center leaves a man some power of speech, but though his hearing is perfect, he can not understand a word of what is said to him. This condition is technically known as "sensory aphasia." Still another aberration, known as "apraxia," leaves a man with his normal faculties of understanding, but, while he is not paralyzed, he is incapable of intelligently controlling certain of his actions. Such a person, for example, when handed a spoon, though perfectly aware of its proper purpose and use, may go through some such ridiculous action as that of combing his hair with the article offered him. Now a curious fact is, that, while the brain is, of course, symmetrical as to its gross structure, its two halves in the adult individual are found to be set apart for an essentially different set of functions. In right-handed persons practically all the higher mental faculties are seated in the left cerebral hemisphere. This dissymmetry in the development of the body and brain is accompanied, not unnaturally, by a certain inequality in the features of the two halves of the face. We are so accustomed to viewing a face as one unit, that the usually slight differences between the right and left sides do not ordinarily strike us. But by a very simple artifice devised by Hallervorden, and described by Dr. Hildebrandt in *Uber Land und Meer*, this peculiarity of the human countenance is brought out clearly. The method has the further advantage that it enables us to instinctively interpret each of the two aspects of the face by that involuntary faculty of judging faces, which is partly innate in us, and partly sharpened by incessant practice. Hallervorden simply takes an exactly full-face portrait of the person who is to form the subject of the experiment, and makes two copies, one prepared in the ordinary way, the other inverted. (This latter is easily obtained if the negative is taken on a thin film, which is then simply copied with the film-side outward.) Each copy is divided in two by an exactly median cut (halving the line between the pupils of the eyes), and the right half of the true copy is joined to the left half by the inverted copy (corresponding to the right side of the original). In this way an entire face is obtained, containing only the features of the person's right side. Similarly a left-sided face is obtained. Our illustrations show a number of portraits treated in this way. It may be observed that the right-sided face has a rather more wide-awake expression in each case than the left-sided face. There is something more passive and lifeless about the left-sided face. The right-sided face seems to express more truly the intellectual character of the individual.

It should be mentioned that the portraits here reproduced are those of right-handed people. In the case of a left-handed person, the relations would probably be reversed.

Left aspect. **Original portrait.** **Right aspect.** **Left aspect.** **Original portrait.** **Right aspect.**

THE RIGHT AND THE LEFT FACE

Nuptial Plumage of Birds

IT has been generally believed that the brilliant plumage exhibited by the males of many species of birds during the spring, that is, during the mating season, is directly connected with the physiological condition of the birds at this time, and various theories have been formulated to account for the facts.

Director Joseph Grinnell, of the Museum of Vertebrate Zoology of the University of California, has found in the California linnet some facts that do not agree with the common belief. In this bird the male presents a very brilliant red breast and neck during the mating season, whereas in the autumn and winter the feathers have a dull grayish coloring, with a mere suggestion of pink. But the bird does not molt (change its feathers) in the spring, nor is there new pigment formed in the feathers. By collecting a series of feathers from August, when the bird does molt, to the following spring and examining these very carefully, it was found that in the new feathers the brilliant red is confined to a narrow band, which is overlapped

by the edge of the adjacent feathers. The overlapping portions are white, and very brittle. During the winter these delicate portions are rubbed off and lost, so that when the mating season arrives, the bird has its brilliant coat. Mr. Grinnell emphasizes especially the fact that this brilliant coloring is actually produced in the fall, after the mating season, at a time of the year when the vitality of the birds is supposed to be at its lowest ebb.

Archæapteryx the Primordial Bird

SCIENCE has its share of romance. More obvious perhaps than in other departments, is this element in palæontology, the science which seeks to reconstruct and spread before our mind's eye the conditions and forms of life upon earth in ages long past, extending back millions of years before the advent of man. The study of the fossil remains of far-off progenitors of our contemporary fellow-inhabitants of this globe speaks to the imagination with an irresistible invitation to summon up before our mental vision a vivid view of the strange and often terrible forms which in the gray dawn of our present era peopled this planet. And the picture which thus rises before us is wonderful enough to satisfy the demands of the most *blasé*, to arouse some interest and wonder in the most matter-of-fact and unimaginative mind.

From *Reclams Universum.*

Fig. 1.—Slab discovered in 1861. Fig. 2.—Slab found in 1877. Fig. 3.—Ideal reconstruction.

ARCHAEAPTERYX THE PRIMORDIAL BIRD

From a more strictly scientific point of view, the principal interest attached to the study of palæontology arises from its relation to the theory of evolution, and the light which it sheds on many phases of the problem of the origin and development of species. From time to time a new specimen is discovered which reveals some feature of surpassing interest, some drastic example of the universal thread which connects all forms of life.

We celebrate this year the fiftieth anniversary of an instance of this kind, and on this occasion C. W. Neumann recalls the circumstances of the case, in an article published in *Reclams Universum*. Half a century ago Dr. Häberlein, a German physician, discovered at Solenhopen a specimen of a remarkable creature, combining in itself some of the essential characteristics of birds with those of a reptile. Impressed upon a slab of the Solenhofen calcareous slate there appeared, in the find of 1861, an almost complete skeleton, considerably shuffled up, it is true, yet clearly enough defined, and scattered among the bones were seen an abundance of large feathers. One remarkable feature, such as is found in no existing bird, was the long tail, containing a large number of vertebræ, and set with a series of long, stiff feathers in fern-leaf fashion. A well-preserved foot (clearly visible in Fig. 1 of our illustrations) is seen to be armed with strong claws. Head and neck were missing on this specimen. It was therefore with great joy that palæontologists received the news, some sixteen years later, that a second, and this time a remarkably perfect specimen had been found, in the same locality as the first. A view of this is shown in Fig. 2 of our illustration. It enables us to form a very accurate idea of the actual character and appearance of the "Archæapteryx," that is to say, "Primordial Bird," as this animal has been termed. The result of the scientific reconstruction of the specimen is visualized in Fig. 3 of our illustration. Archæapteryx possessed a pair of wings, with which it doubly propelled and sustained itself in mid-air, after the manner of a bird. But these wings were not as yet so completely specialized as those of a true bird. The digits, which in birds are entirely fused into the wing, projected and were armed with claws, and were evidently used by Archæapteryx to take hold of objects, such as the branches of trees, to assist in supporting himself, and perhaps in climbing. The form of the vertebræ, and especially the long tail, are quite characteristic of a reptile, and the mouth or beak is armed with strong teeth, a feature absent in the adult bird, but of course quite characteristic of reptiles. It is interesting, by the way, to observe that in the course of their embryonic development true birds pass through a toothed stage. It is a well-known fundamental law of biology that every individual, in the course of his development, recapitulates in more or less distinct (though, of course, abbreviated) sequence, the stages through which his species as a whole has passed in its evolution during past generations.

Palæontology and embryology therefore unite in this, as in so many other instances, and by their evidence proclaim the origin of the feathered folk. It appears that the remote ancestors of the birds were winged reptiles. And the Archæapteryx takes its place near the transition line—not quite bird, yet more than reptile, it stands as a connecting link on that slab of Solenhofen slate, a page in the earth's historical record of ages long gone by.

Measuring Your Intelligence: John Gray's New Instrument for Testing "Perseveration."

NO science makes much progress until its votaries succeed in applying to its phenomena the methods of exact measurement. The sciences of chemistry and physics, after the introduction of exact methods of weighing and of measuring space, temperature, and potential, advanced by leaps and bounds. We have good reason, therefore, to believe that the application of measurement would lead to a corresponding great advance in that science, by no means the least important, which deals with the evolution of man himself.

An instance of such an application is described by John Gray in our contemporary *Knowledge*, from which we quote the paragraphs which follow:

"It will be convenient, in explaining the nature of the exact science of man, or, as it is usually called, anthropometry, to regard man as a machine, comprising a framework or structure and highly complex functions.

"To measure the framework of man is a comparatively easy matter. With the graduated rod and the calipers we can measure statures, head diameters, and other dimensions of the body; and the weight can be measured with the weighing machine.

"The simpler physiological functions, such as acuity of vision, color vision, and other sensory characters, can also be readily measured. But when we come to deal with the more complex physiological functions, those usually known as psychological, the difficulty greatly increases.

"The value of measurements of psychological or mental characters is, however, so great that strenuous efforts have recently been made by anthropologists to discover some more or less exact methods. Intelligence, for example, plays so important a part in all the affairs of human life, that a fairly accurate method of measuring it would be of the greatest practical value to the educationist, to the military or naval officer, and to the business man, not to speak of the impulse which it would give to the science of man.

"Most of the methods of measuring intelligence at present in vogue are personal estimates by teachers or others who are acquainted by long experience with the mental character of the person to be tested. These methods have been found to be only very rough approximations, as there is by no means good agreement between the results obtained by different observers.

"The examination test is recognized as a good test of intelligence, but it involves other factors which have little or nothing to do with intelligence, and its correlation with success in after life is not very high.

"It appears to me that simple and exact methods of measuring certain physiological properties of the brain which have a great influence on our mental growth, promise to give much more valuable results in the measurement of mental character than either the personal estimate or the examination test.

"As an example of this I take the measurement of the persistence of a nervous current or disturbance in the brain after the external impulse has ceased.

"For this purpose I have devised a simple apparatus by which flashes of colored light can be thrown in rapid succession into the eye. (See Fig. 1.)

"The apparatus consists of a revolving mirror, the axis of which is horizontal, and which can be turned at any required speed by a handle and belt gearing. The speed at which the axis is rotating at any instant is shown by a speed indicator connected to its free end.

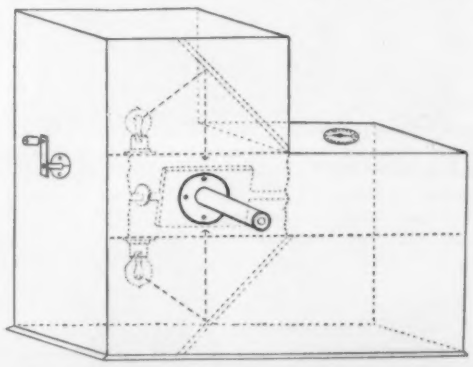


Fig. 1.—Apparatus for measuring perseveration.

An instrument that tells whether or not you are a genius.

THE MEASUREMENT OF PERSEVERATION AND ITS VALUE AS AN INDEX OF MENTAL CHARACTER

"The mirror revolves in a dark box having windows of colored glass directly above and below the mirror. Outside each window is a screen of white paper fixed at an angle of 45 deg. to the plane of the glass, and illuminated by an electric glow lamp, or by other constant source of light.

"A beam of diffuse light thus passes through the colored glass of the window and impinges on the mirror. As the mirror revolves, the colored reflected beam passes over an aperture in the side of the box, against which the eye of the person being tested is placed. When the reflected beam has passed over the aperture, the color impulse on the retina ceases until the mirror has reached the position in which it reflects the next colored beam of light into the eye.

"The experiments of Shelford Bidwell, and of others, have shown that the sensation of a color persists for a short time after the external impulse has ceased. If the duration of this persistence is equal to

the time interval between two successive impulses from the revolving mirror, the color will appear to be continuous. But if the persistence is less than the time interval, the color will appear to flicker.

"In order to measure the duration of the persistence in any given person all that is necessary is to ascertain from the speed indicator on the axis of the mirror, the exact number of revolutions which the axis is making when the flicker disappears. It is best to start very slowly, and gradually increase the number of revolutions of the mirror until the flicker disappears. The reading is taken from the speed indicator at this critical speed. The persistence of color sensations in the person being tested is inversely proportional to the critical speed.

"Experiments made by Nichols, Ferry, Abney, Burch, and Allen show that color blindness causes an abnormal increase of the persistence of the primary color or colors to which the subject happens to be blind.

"The same apparatus can thus be used as a test of color blindness. After we have obtained sufficient statistics of the persistence of persons with normal color vision, we may safely reckon any abnormal deviation from this average as an indication of color blindness.

THE DETERMINATION OF MENTAL CHARACTER.

"This persistence of a color sensation after the stimulus has stopped, which we have been discussing, is identical, or very closely related to a quality of mind which the psychologists call perseveration. The amount of this perseveration is probably a fundamental property of the germ plasm, and, therefore, inherited from our ancestors.

"The growth of the mental character of an individual as he passes from childhood to maturity is greatly influenced by the amount of his perseveration.

"Perseveration influences mental growth by the control which it exercises upon the formation of associations between two or more neural systems.

"When a nervous impulse passes through a neural track in the brain it reduces the resistance of the track, so that following impulses pass with much greater facility.

"This diminution of resistance by the passage of a nervous impulse is called the law of neural habit. According to James, the law of neural habit is the foundation of all mental growth. From the psychological point of view this is equivalent to saying that all mental growth consists in the formation of associations between different perceptions.

"In order to form an association between two perceptions the neural systems in the cortex of the brain, which represent these perceptions, must be excited in immediate succession. For example, a child, when looking at a ship, is told its name. The name is ever afterwards associated with the appearance of the ship in the mind of the child.

"What has taken place in the brain of the child? The neural system, *a*, representing the visual perception of the ship, was first excited, and immediately afterward the neural system, *b*, representing the auditory perception of the name of the ship, was excited. The effect of the total operation was to form a path of reduced resistance between *a* and *b*, so that when *a* is next excited a nervous current passes across to *b*, and creates an image of the name of the ship.

"According to McDougall's theory, the excitement of *b* exerts a guiding influence upon the discharge from *a*, determining the discharge to take place from *a* to *b*. A physical analogy which helps to explain this phenomenon is the passage of an electric spark from a point at high potential to another point at low potential. The point at low potential determines the direction in which the spark will leave the point at high potential. The passage of the spark through the air reduces the resistance of its track, though this reduction lasts for a comparatively short time compared with the diminution produced in the neural track connecting *a* and *b* in the cortex of the brain.

"The condition, however, to which I wish to direct special attention is that the difference of potential required to form an association track between *a* and *b* is produced only when the wave of excitement passes through *a* immediately before the second wave of excitement passes through *b*. It is necessary also that the excitement of *a* shall be very much reduced before *b* is excited.

"The conclusion forced upon us by the above considerations is that anything which retards the rate at which the excitement of a neural system dies out, reduces its power of forming associations with other neural systems. But when once an association, i. e., a track of low conductivity is formed, say, by sufficient repetitions, the nervous currents which flow through the track will last longer.

"Now, the property of high persistence, or perseveration, which we measure by the apparatus described above, will have the effect of retarding the disappearance of the excitement in a neural system.

"We should expect, therefore, that persons with high perseveration would form new associations with great difficulty, and persons with low perseveration would form them with great ease and rapidity.

"Dr. Otto Gross, in his treatise on the Secondary Function, has deduced in a most ingenious way, from this physiological hypothesis, the different kinds of mental character that are likely to arise, from various amounts of the secondary function, or, as we have called it, perseveration.

"From the conclusions arrived at by Gross I have drawn up a scale of perseveration, and the kind of character likely to be associated with different degrees of perseveration, in the ordinary conditions of life.

"At the center of the scale we have the average amount of perseveration, which is associated with the practical common sense of the average man.

"When the perseveration is below the average the speed with which ideas flow through the mind is quickened, and the readiness with which the mind receives external impressions is also increased.

"The first category below the average, therefore, contains persons with witty, brilliant, and suggestive minds, persons of great tact, presence of mind, and daring; all of which imply quick response to external stimuli.

"To this class would belong the majority of persons who are popularly considered to be geniuses. But if we adopt Carlyle's definition of genius as 'an infinite capacity for taking pains,' the genius would have to be looked for in the class having perseveration one degree above the average.

"The category with perseveration one degree above the average contains persons who are fond of abstract thinking, and who follow a theme into all its ramifications. They think slowly and learn slowly. The scope of their consciousness is wide, but they are not quick of apprehension because they do not respond readily to outside stimuli.

"We may say, therefore, that the classes with perseveration one degree below the average and with one degree above the average, produce geniuses of different types, who, while they excel in one direction, have also certain defects associated with their excellent qualities.

"When we pass to the classes of persons with perseveration two degrees above or below the average, these defects are intensified, and serious deterioration of mental character begins to appear.

"The category with perseveration two degrees *below* the average contains persons who cannot keep their thoughts long on one theme; frivolous persons who are fond of superficial associations, such as punsters and cynics; persons to whom all emotions are of equal value and who are consequently of weak moral character; persons who learn anything new very quickly but superficially.

"On the other hand, the category with perseveration two degrees *above* the average contains persons with quite opposite defects. The long duration of the secondary function interferes with the formation of wide associations, and renders the limited associations formed exceedingly stable and inaccessible to outside influences. This corresponds to the person with fixed ideas, apparently founded on sentiment rather than on reason. Gross somewhat invidiously includes in this category vegetarians and anti-vaccinators, but it is preferable to leave the truth of that assertion to be determined by experiment.

"When perseveration falls below, or rises above that of the two categories last described, the mind becomes unstable—we pass from the sane to the insane.

"The insanity at the two extreme ends of the scale is of quite different types. Persons with excessively low perseveration are liable to *acute mania*, and persons with excessively high perseveration usually suffer from *melancholia*.

"The symptoms of these two classes of the insane are deducible by Gross's hypothesis from the influence of excessively low or excessively high perseveration on the formation and action of the mind.

"A considerable number of persons of both sexes have been measured with the revolving mirror apparatus, in the Anthropometric Bureau at the Japan-British Exhibition.

"Though the whole of the data obtained have not yet been analyzed, the following are some of the results obtained from the measurement of eighty-two men and twenty-six women.

COMPARISON OF THE PERSEVERATION OF THE TWO SEXES.

"The first question I set out to determine was whether there was any significant difference between the average perseveration of the two sexes.

"I found that the mean perseveration of the eighty-two men was 153.6 units; while the mean of the twenty-six women was 138.6 of the same units.

"This amounts to a difference of fifteen units between the average perseveration of the two sexes.

"We arrive, therefore, at this important conclusion—that the average perseveration of women is significantly less than that of men.

"This lower perseveration of women we should expect to be associated with the mental characters indicated on our scale, i. e., we should expect in women greater quickness of apprehension, tact and presence of mind than in men, with a diminution of those good qualities which are associated with high perseveration. This, I think, agrees pretty well with general experience.

COMPARISON OF PERSEVERATION OF LIGHT AND DARK-HAIRED PERSONS.

"The next point I endeavored to determine was whether there was any real difference between the perseveration of light and of dark-haired persons.

"Hair color being a very valuable criterion of race in northern Europe, we might expect to decide from the results obtained the difference between the characters of the fair Anglo-Saxon element and the dark Mediterranean element, in the population of the British Isles.

"The hair colors were classified in two categories, namely, light, including fair and light brown; and dark, including dark brown and black.

"I find from my figures that the average perseveration is as follows:

Light-haired persons	154.5
Dark-haired persons	150.1

"This suggests that the Anglo-Saxon race has somewhat higher perseveration than the dark Iberian, or Mediterranean, race, and the mental characters associated with the various degrees of perseveration that are to be expected in these races."

Inheritance of Size and Shape

IN his experiments on inheritance, Prof. W. E. Castle of Harvard found that when rabbits having ears of different lengths were crossed, the offspring had ears of intermediate length. Similar results as to the "blending" of a character had been obtained in the case of Indian corn, where varieties that have different characteristic heights would produce hybrid offspring of intermediate heights. From these facts the generalization had been drawn that in matters of size inheritance was likely to be "blended." Exceptions to this law were known: most conspicuous is the case of the sweet pea, with which Mendel himself had experimented. In this group of plants it was found that when a dwarf variety was crossed with a tall variety, all the hybrid individuals were tall; but in the following generation the two characters were seggregated out in the typical Mendelian fashion. Castle explained the difference between the behavior of the sweet peas and that of the maize or the rabbits' ears by assuming that the "dwarf" sweet pea was a form possessing a distinct, discontinuous character, whereas in the case of the Indian corn the varieties are simply fluctuating variations, so far at least as the size is concerned.

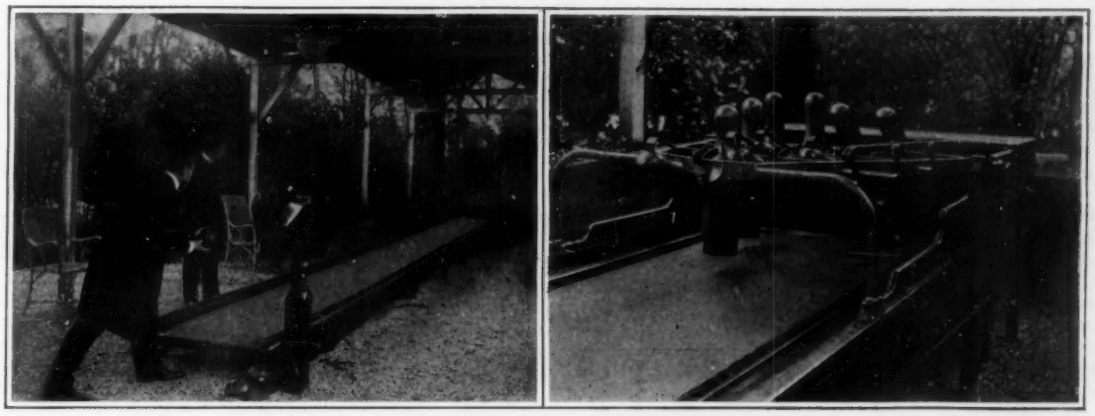
R. A. Emerson, Professor of Horticulture at the University of Nebraska, has carried on some experiments on this problem and concludes that in the matter of size, as in certain other characters, the inheritance is truly Mendelian. He used size of grain and tallness of stalk in Indian corn, size and shape of summer squashes, size and shape of gourds, and size, shape, and weight of various kinds of beans as characters for his test. In all cases he found that the first hybrid generation always gave quantitative results intermediate between the two parental characters. But on breeding from the new plants for another year he obtained results that point to a real seggregation, although the facts of size and shape are more complex than the facts of color inheritance. In this third generation he obtained individuals that were as large as the larger of the two grand-parents; some that were as small as the smaller grand-parent; some that were of the same size as the hybrid parent; and some intermediate between the hybrid and the two extremes. It would be necessary to breed for at least one more generation before the separation of characters can be completed; and it is planned to continue the experiment this year (1911).

Contrary to widespread belief, the first hybrid generation did not show any greater range of variation than either of the parent forms; hybridization does not create new characters. It was also found that the ratio between length and breadth in the different seeds, fruits, etc., studied were not materially influenced by the crosses, so that the shapes of the hybrid organs were the same as those of the parents, so far as the conditions would allow. One of the special difficulties involved in carrying on experiments of this nature is the fact that the outward conditions of temperature, illumination, moisture, etc., so readily modify the measurements, that in some cases it would be impossible to tell whether a little extra tallness or weight was evidence of an inherited character, or the result of favorable nutrition.

Curiosities of Science and Invention

Novel Contrivance for Bowling Alleys

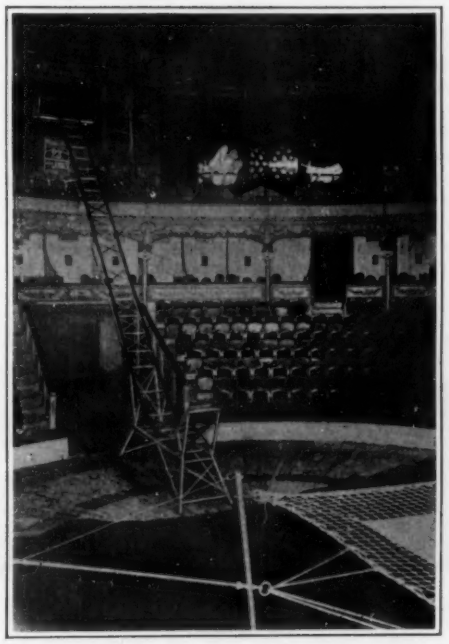
TO do away with the necessity of setting up the pins in a bowling alley after they have been bowled over, an ingenious inventor has contrived an automatic device. The pins are hinged to a frame that extends over them, and when they are struck by the balls, they are swung upward instead of being knocked down, and are held in this position by means of a spring catch on each pin. The bowler may reset the pins by pulling a lever, which releases the catches and permits them to drop to normal vertical position. While this arrangement of setting the pins has the advantage of placing the pins always in correct position, so that the bowler need not blame the attendant if he fails to make a strike, it also possesses the disadvantage, particularly to the novice, that the pins do not knock each other down helter skelter, as in the usual game. Hence the game must be more scientific. The inventor has also provided a felt floor for the bowling alley, so that the balls in rolling down the alley will make no noise.



Bowling alley with felt-covered floor and device for setting the pins automatically.

A Human Diabolo

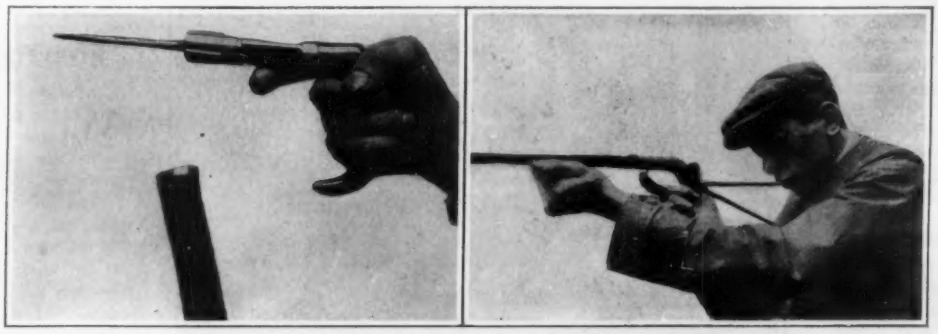
THE man who tries to invent a "thriller" that will surpass previous daring circus performances has a difficult task in these days, owing to the fact that almost every conceivable method of tossing the human body about in loop-the-loops, in somersaulting automobiles, out of cannon, etc., has already been done. In thus making a plaything of human life, it is natural for him to turn to children's games for suggestions. Recently an inventor has conceived of using the idea employed in the game "diabolo." A large spool or diabolo is made to roll down a steep inclined plane, and thence is shot up into the air, landing finally on a net. Within this diabolo, with her head and shoulders projecting, is a young Parisienne, Mme. R. Furie, who undergoes the performance without any serious consequences, despite the fact that the centrifugal force developed by the rapidly revolving diabolo must produce a tremendous strain on the muscles, to say nothing of the dizziness caused by the rapid whirling.



The human diabolo rolls down the steep incline and is tossed into the air.

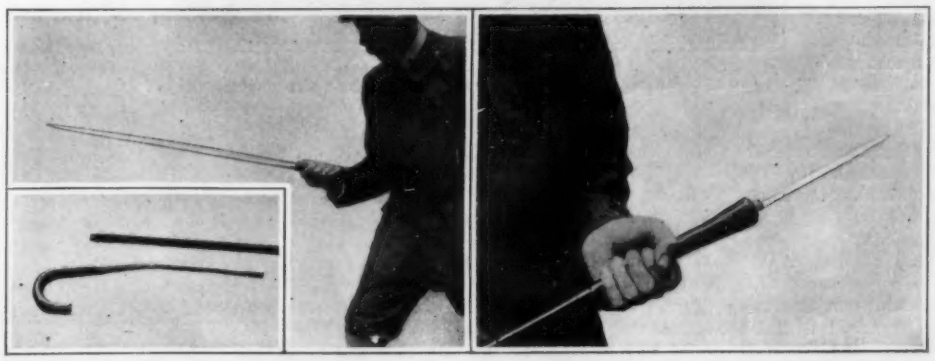
Weapons in Walking Sticks

THOSE who look with contempt upon a cane as a useless ornament and a harmless weapon evolved from the old-time bludgeon, evidently do not know much about the condition of affairs in France, where the inoffensive-looking walking stick may conceal the most dangerous weapon. In France, the carrying of arms is prohibited. On the other hand, the respectable citizen is frequently obliged to protect himself against the "Apachos." For this reason, considerable ingenuity has been exercised in concealing within the otherwise innocent-appearing walking stick a most efficient means of defense. To such an extent has this art been carried, that one need no longer look with contempt upon the well-dressed dandy twirling a light cane, for at a moment's notice he may wrench off the handle of his walking stick and blaze away at you with a six-barreled revolver. Should this fail to down the enemy, he may use the dagger projecting from the barrel of the revolver for short-range fighting. One of the accompanying illustrations shows a rifle that has been concealed in a walking stick. The rifle is provided with a shoulder rest, which may quickly be unfolded and applied. Another illustration shows a sword that has been drawn out of a cane, while still another illustrates a cane so constructed that a simple movement of the stick will bring out a bayonet from the upper end. There is one form of weapon that might be of service to the gentleman, but we are inclined to think that it would be of more value to a footpad. The stick contains an ugly blackjack consisting of a rubber whip loaded with a heavy metal end.



The handle is a six-shooter and dagger.

The cane makes a first-class rifle.



The cane may contain a sword or a blackjack.

A twist of the stick projects a bayonet from the handle.

WEAPONS CONCEALED IN FRENCH WALKING STICKS

Electric Traction

AMONG the most recent projects in the way of electric traction on standard-gage railroads, we note the plans which the South Railroad of France is making upon the Bayonne-Toulouse railroad in the Pyrenees region. Owing to the difficulty of operating by steam, a part of the line will use electric trains with specially designed locomotives for the heavy gradients. A single-phase 1,200-horse-power locomotive weighing 90 tons will be used, also a type of motor car with four 125-horse-power motors. Two hydraulic plants and perhaps a third will be erected for the current supply, working the power lines on the three-phase 55,000-volt system. The first plant at Eget will use a high fall of 2,500 feet, and a second plant will be located at Pierrefitte. About $1,000,000 will be needed for the plants, not counting the machines. Substations will deliver the current to a trolley wire which takes 12,000 volts. Transformers will be placed on the locomotives for lowering the voltage for the motors. On one of the leading railroad lines of Switzerland, the Rhätische Bahn, there are to be three sections laid out for electric traction, the Bevers-St. Moritz and two others. Current will be supplied from the great Brusio hydraulic plant lying near the Italian frontier. Among the local lines which are to be specially built for electric traction we note the light railroad running from Rome to Anticoli and Frascati. It will be about 80 miles long. Milan is the starting point of a 25-mile electric traction line running to Ombriano and other towns. In the Italian lake region a tourist electric road will be built between Intra and Premeno, so as to give access to the mountains adjoining the lakes. In order to cross the mountains by the St. Bernard route and connect the railroad station of Martigny and Orsières, there is building a standard-gage line which will rank among the prominent railroads of this class in Switzerland. Owing to the nature of the region which it traverses, following as it does the beautiful valley of the Drause River, this road calls for much engineering skill and ingenuity and will require a considerable amount of construction work in the way of bridges and tunnels. All of which will add greatly to the charm of travel through this picturesque region.

The Schilowsky Low-speed Gyroscope Monorail

A Method of Maintaining Equilibrium With a Comparatively Slow Gyroscope

By the English Correspondent of the Scientific American

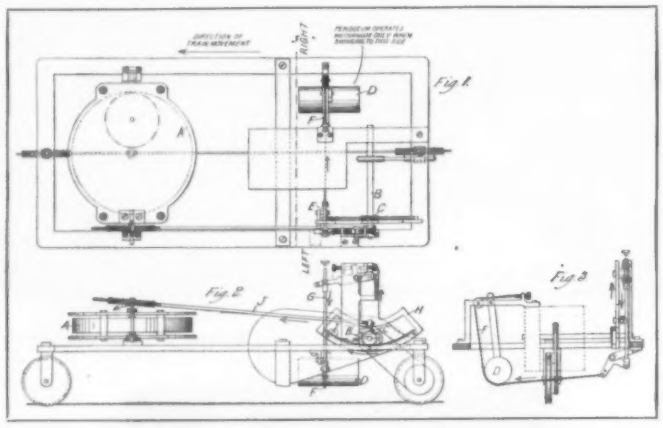
DURING the past few months, engineering interest in England has been occupied by a new gyroscope monorail system, which possesses many interesting and novel features. It is the invention of his Excellency, Monsieur Pierre Schilowsky, the governor of Kostroma, Russia, who personally carried out the initial demonstrations in London with the small model which he had constructed. Through the courtesy of his Excellency and his consulting engineer, Mr. George Eckford of Kensington, we are enabled to describe the outstanding features of this system.

The inventor, although adopting the gyroscope as a means of maintaining equilibrium on a single line, has elaborated a new means of utilizing this principle. There is a special regulating mechanism, by means of which any deviation from the proper horizontal position of the gyroscope, and the vehicle upon which it is mounted, is immediately and automatically effected. The outcome of this arrangement is that a high velocity on the part of the gyroscope, with its attendant difficulties and dangers in regard to mounting, is not necessary. A low gyro-speed dispenses with the necessity of securing a very accurate balancing, fine workmanship, and working *in vacuo*, as in the case of the high-speed system, with the result that greater simplicity and more facile control of the machinery is secured.

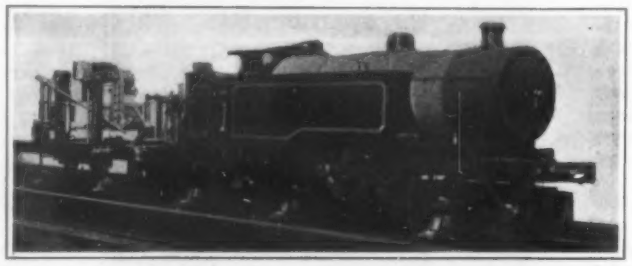
This inventor advocates the mounting of the gyroscope and its attendant mechanism upon an independent vehicle or gyro-car, but this is not essential. In the model experiments he adopted the arrangement shown in the accompanying illustrations, the monotrain being built up as follows: Locomotive, gyro-car, two coaches, gyro-car, two coaches, and so on throughout the length of the train; but many other modifications are practicable. Steam or electricity may be used as the motive power for the train, gyroscope, and regulating mechanism, according to which type of prime-mover is the more convenient.

The principle of the system may be gathered from the accompanying diagrams. The gyroscope *A* mounted on its car is driven by an independent engine or motor. The shaft *B* and pinion *C* are driven constantly by a second independent engine at a low speed. When the pendulum *D* swings to the right, owing to the oscillation of the car, it pulls the crank *E* through the chain *F*, thereby drawing down the rod *G*, which pulls up the internally-toothed quadrant *H*. This action causes teeth *I* to engage momentarily with the pinion *C*, so that the quadrant thus gets a "kick" forward. This "kick" is conveyed through *J* to the gyro frame in the direction of the deviation of the gyroscope. The latter immediately "kicks" back toward the horizontal position, and continues its oscillation backward, but through a smaller arc. When the gyroscope again oscillates forward, the regulating mechanism again intervenes, but less forcibly, until, after a few diminishing oscillations, the gyroscope remains perfectly horizontal. It must be pointed out that these "oscillations" are very small, the correction being extremely sensitive. It must also be observed that the shaft *B* and the pinion *C* are always rotating. It is quite immaterial whether the first disturbing oscillation of the car be to the left, which would not actuate the regulating mechanism; for the next oscillation would be to the right, and the pendulum would pick this up immediately.

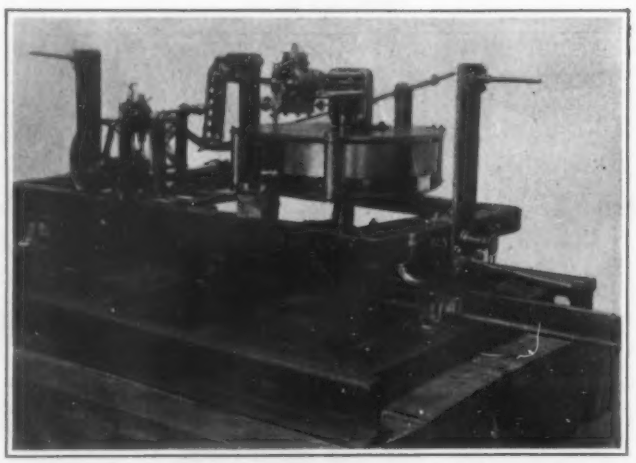
The inventor is at present engaged in the construction of a full-sized train and track built upon this principle in his home country, the experiments with the models having proved so successful that the Russian government engineers have expressed a desire to see the system in actual operation under normal conditions, with a view to its adoption as an inexpensive means of transportation in the sparsely populated districts of the empire.



Plan and elevations of the gyroscope and balancing mechanism.



Gyroscope and mechanism carried on an independent car coupled to the locomotive.



The gyro-car, showing the balancing mechanism which enables the use of a slow-speed gyroscope.

Improved Letter Boxes

IF the committee which the Postmaster-General appointed some time ago to determine upon a style of new street letter box which may come to the requirements of the service makes a favorable report, one may see at no late date a new and novel device for the reception of letter mail.

As yet the exact style and design have not been decided upon, but it is safe to assume that the new box will add beauty to any street corner.

There are several factors entering into the proposed change in letter boxes, and they are not minor ones either. Heretofore the letter boxes have been unhandy to the collectors, and it has entailed more time to unlock and close them than has seemed necessary. What the Post Office Department has in mind is the introduction of a letter box which may be emptied with one motion.

Time also enters into the case, and it is demonstrated that many hours can be saved each day, more trips may be made by the collectors, and better service in the handling of mail can be had with a letter box which will permit all the mail to be taken out at one movement. With a principle of this kind, the box may be emptied in two or three seconds. This means a saving of at least twenty seconds at each box, and in the end means a saving of nearly seven hundreds hours every time a collection is made throughout the United States. Looking at it from the standpoint of economy, and considering that in most of the larger cities there are often ten and more collections a day, shows a big waste in postal funds.

It is proposed also to have a time indicator and an indestructible card attached to the box, which will show the time at which the next collection is to be made. Several devices have already been experimented with by the Department, but the results have not convinced the officials of the adaptability of the boxes. One device experimented with consisted of a set of cards, set into an endless chain, each bearing a different title. When the box was opened, a new card was automatically advanced before the opening in the front of the box, on which was printed the time of the next collection.

There is one point made in favor of the automatic register boxes, and that is that it places a check on the collector, and prevents him from skipping a box by design. If the next collection is not made at the proper time, the indicator will show the fact to any one who examines the box.

For several years past the Post Office Department has considered new styles in letter boxes, and many of them have been given trials in some large city, where their operation might be closely watched. None of these, however, has met the demands of the Department.

The Department has extended an invitation to those having ideas on the subject to submit plans and drawings of improved letter boxes to the First Assistant Postmaster-General, under whose jurisdiction the matter comes.

Those who contemplate entering plans should bear in mind that several things should be taken into consideration, and that they are important factors that enter largely into the success of their venture: Economy of time for the collector, artistic appearance of the box, an indestructible time card, and an automatic indicator. To be sure, the time card becomes unnecessary if the automatic indicator works satisfactorily, but it must be considered as part of the plan.

Five Times in Four Hundred Years

WITH the beginning of the second decade of the twentieth century (1911) some very strange and interesting facts are deduced.

That the beginning of 1911 being on Sunday, the first day of the week, the first day of the month, and the first day of the year, is not so strange as that the first day of the decades are very few that start out on Sunday. This singular coincidence in the decades has occurred before only five times in just four hundred years, when in 1511, according to the Gregorian calendar (new style), it was the same as now, 1911. Again it occurred in 1561, then again in 1651, and again in 1741, and then the last before now was the beginning of the decade 1871, forty years ago. The next time that it will occur will be 1961, or fifty years hence, and the next time after that will be 2051; then again in 2141, the next in 2271, and then again in 2311, or four hundred years from now, and so along down through the ages at periods of four hundred years from each of the years given above. It is also very interesting to note that since the beginning of the Christian era, according to the Julian Old Style Calendar, that the seventh and fourteenth centuries, that is, 601 and 1301, are the only centuries up to the present time that have started off on Sunday (the first of the week, month, and year), and according to the present calculating of time, it will never occur again.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Report Mufflers for Firearms

An Interesting Field of Invention

ONE of the most characteristic features of our era is the dominion which man has gained over the brute forces of nature. The steam engine has multiplied the strength of his arm a thousand-fold. The dweller in the modern metropolis scarcely passes an hour of his working day without borrowing power from nature's store, or tapping one or another thread in that network of nerves which has grown through and through our civilized communities, establishing connections everywhere, and uniting into one sentient body the entire nation. For the modern man has not one pair alone of eyes or ears, narrowly limited to the perception of events taking place in his immediate neighborhood. Through a multitude of windows his mind looks out over a horizon stretching from ocean to ocean, and from the gazing eye, the listening ear, the news is presently flashed along the wires of telephones and telegraph, or, since but yesterday, through the unaided ether, to a thousand conscious minds, the soul of the community.

This have science and the ingenuity of man done for the arts of peace.

But our present era is a child born of war. Some of the earliest applications of nature's inorganic forces to man's use were made in weapons of defense and attack. If modern man has harnessed the unruly force of explosive disruption in motors to assist his peaceful pursuits, we call to mind that he first made use of this agent many years before the rise of modern industrialism, for purposes of war. The archer of yore stretched his bow by the strength of his arm, and nothing but that strength was imparted to the arrow presently sped from the bow. With the advent of fire-arms an almost unlimited power was placed in the hands of each combatant, a power altogether out of proportion with his own inherent energies. Yet not without sacrifice was this advantage gained. The arrow flies almost noiselessly from the archer's hand. The blunderbuss proclaimed by a loud report the origin of the missile, and enveloped the sender in a cloud of smoke which confirmed and amplified the evidence of the report, and at the same time for a space dimmed his vision. It is true that the modern gun, fired with "smokeless" powder, in a measure avoids these defects. The report from a large cannon however is not only audible at great distances, but may, owing to its extreme violence, cause positive injury to those stationed in close proximity. The recoil of fire-arms also is an undesirable effect, if only in view of its unfavorable influence upon the accuracy of aim. The escape of gases in irregular eddies from the muzzle of the gun has a similar effect.

Inventors have accordingly for many years past endeavored to overcome some of these disadvantages. The result of such efforts has been the production of a number of gun "silencers" or "mufflers," of which some typical examples are shown in our illustration. For some of these it is claimed also that they reduce the "recoil" of the fire-arm. To what extent this latter effect is realizable appears somewhat doubtful, for the recoil is at least in a large measure due to the reaction of the missile, and this can not possibly be avoided. Only that portion of the recoil may be reduced which is due to the backward force exerted by the gases escaping from the muzzle after the expulsion of the shot.

A device which is designed primarily for this purpose of reducing the recoil is shown in Fig. 4. It consists of an attachment to be secured to the mouth of a cannon, and made in the form of a partitioned casing, of annular cross section. Through the central channel the shot passes out, while the gases rushing after the same are in a large measure diverted outward into the chambers formed by the radial partitions, and opening into the central channel. The portion of the gases so diverted impinges against the front wall of the casing, thus producing as it were a "forward" recoil, if we may be permitted to use this phrase, and in part neutralizing the regular (backward) recoil. We are not aware that this device has come into use, nor does it appear to possess the qualities which would make for success.

The basic principle of practically all the other types of silencers is the same. The endeavor is to impede the exit of the explosion gases from the muzzle, so as to convert their ordinarily sudden motion into a more or less gradual progress. The actual means employed in the effort to obtain this effect vary considerably. The device shown in the first cut of Fig. 1 consists of a valve which is depressed by the sudden onrush of gases after the bullet has escaped. The motion of the valve causes the partial closure of the bore, so that the gases can escape only through narrow ports provided for this purpose. The device depicted in Fig. 2 consists of a casing affixed in front of the gun-barrel, and containing a series of baffle disks. These disks are each split by a radial cut, and joined together in helical arrangement. A number of holes in alinement with the bore of the barrel allow the passage of the bullet.

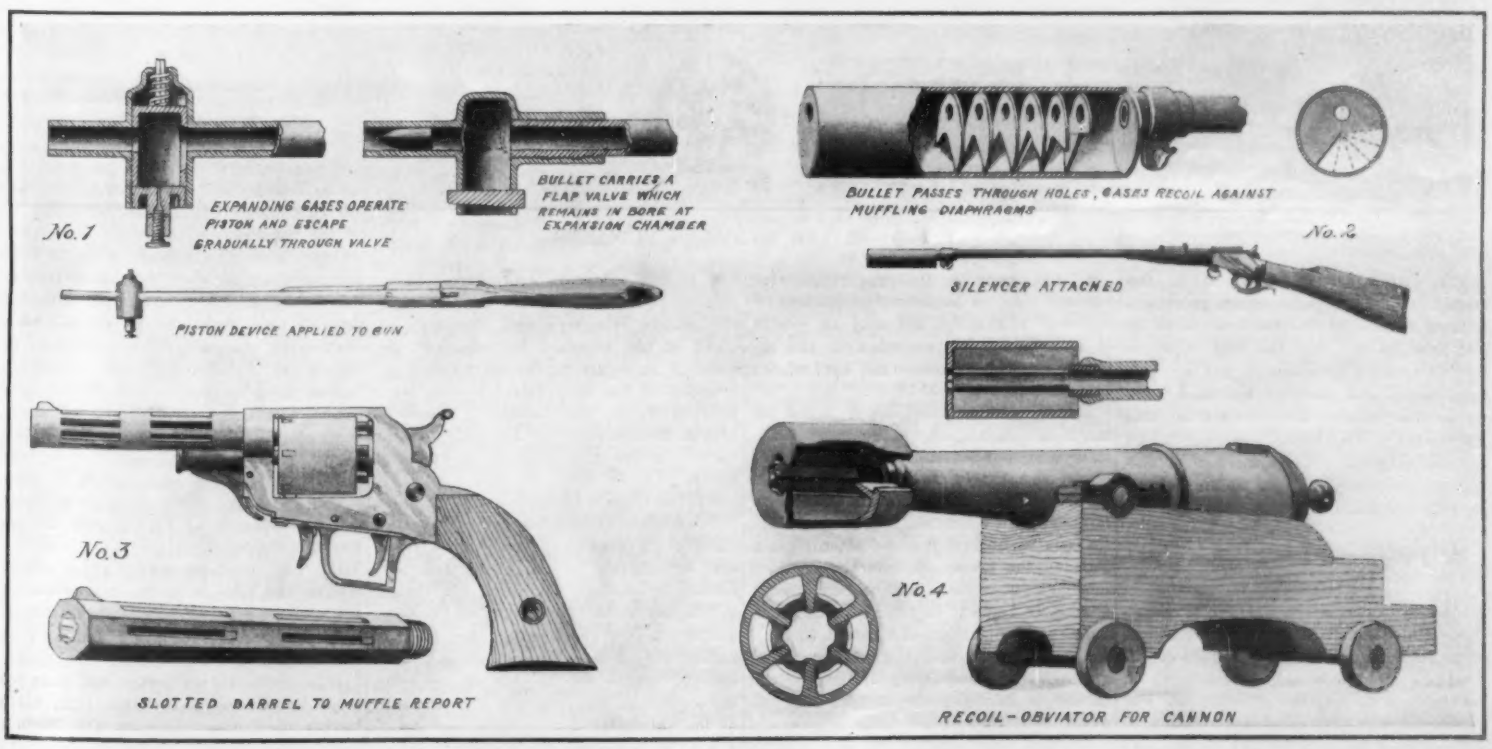
Similar in principle to this device are the Maxim deflector, shown in the upper portion of Fig. 9, and the same inventor's silencers represented Figs. 8 and 10. These may be said to differ merely in the particular shape of the baffles employed. The baffle disks of Fig. 9 are especially designed to impart a whirling or eddying motion to the gases. The "hollow ball" muffler contains a number of spheres which engulf the issuing gases. Each sphere is held in place by shoulders in the side of the casing, and is of course provided with a hole in alinement with the path of the bullet. The lower detail view in Fig. 10 shows one of the balls in section. The median rib serves to strengthen the sphere and prevent its collapse under the force of the blast.

The deflector shown in the lower drawing of Fig. 9 is divided into a number of cells or chambers through which a median channel for the passage of the projectile extends.

In each cell are disposed a series of stationary vanes or blades, arranged as represented in section on the right. As the gases leave the muzzle of the gun and expand, they acquire, by the action of the blades, a rapid whirling motion which causes them to hug the wall of the chamber, and arrests their progress. In this way they pass somewhat gradually from chamber to chamber and finally issue with greatly reduced velocity.

A rather different type of device is presented by the slotted barrel shown in Fig. 3, and the perforated muzzle seen in Fig. 7. In these forms of muffler the plan is to provide lateral exit channels for the gases, after the bullet has passed a sufficient distance along the barrel of the gun. The effect aimed at is two-fold. In the first place, by allowing the gases to escape through a number of comparatively small openings in series, a somewhat gradual release is secured. And secondly, since these gases issue laterally, and before reaching the muzzle, the disturbing effect upon the bullet of the necessarily irregular blast from the muzzle is at least in part avoided. The inventor of the form silencer shown in Fig. 7 has sought to increase the latter effect by arranging the ports in the sides of the barrels at various angles, some radially, some inclined, so as to produce a diffuse blast, and break up the stream from each port.

The inventor of the silencer shown in Fig. 5 works on the theory that the report of a gun is due to the sudden inrush of air into the barrel, when the vacuum first formed by the discharge gives way

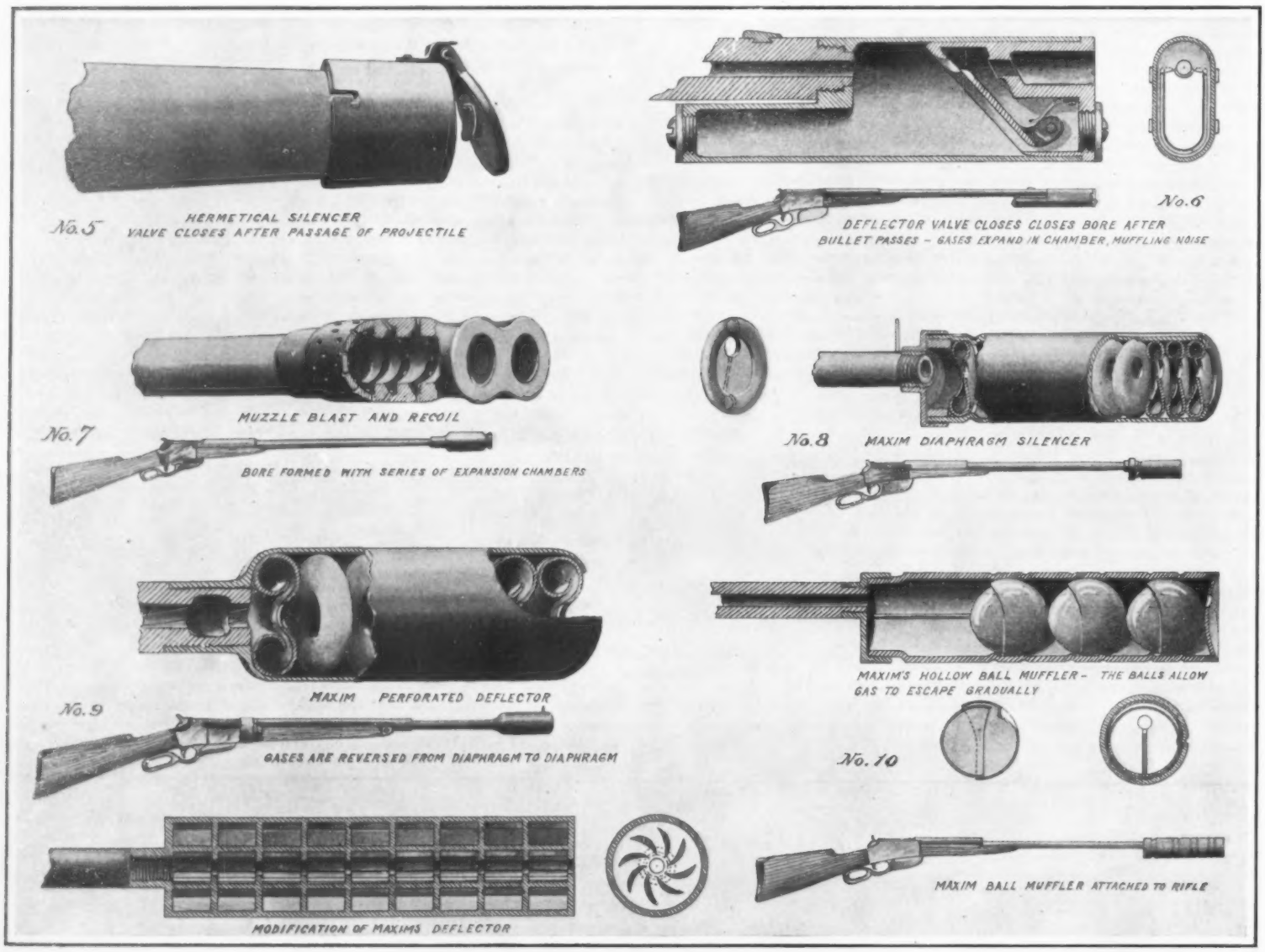

No. 1
EXPANDING GASES OPERATE PISTON AND ESCAPE GRADUALLY THROUGH VALVE
BULLET CARRIES A FLAP VALVE WHICH REMAINS IN BORE AT EXPANSION CHAMBER
PISTON DEVICE APPLIED TO GUN
No. 2
BULLET PASSES THROUGH HOLES, GASES RECOIL AGAINST MUFFLING DIAPHRAGMS
SILENCER ATTACHED
No. 3
SLOTTED BARREL TO MUFFLE REPORT
No. 4
RECOIL-OBVIATOR FOR CANNON

DEVICES FOR SILENCING FIREARMS

under the pressure of the atmosphere. He accordingly provides a valve at the mouth of the cannon, which is opened by the rush outward of the explosion gases, but is automatically closed by the subsequent inrush of air. The valve has a central aperture of moderate size, covered by a flap which opens inward. In this way the inventor aims to admit air somewhat gradually, so as to prevent or reduce the report. This device seems to have a number of weak points, which will be obvious to the reader.

A muffler also working by means of a valve, though on a rather different principle, is that shown in Fig. 6. Here the outgoing blast closes a valve immediately after the passage of the bullet, thus imprisoning the explosion gases.

The problem of constructing an efficient gun-muffler can hardly be said to be satisfactorily solved. We leave it to the reader to pick out some of the shortcomings of certain of the devices shown in our illustration. But the first requisite toward making advances in any art is a familiarity with all that has been done up to the present date. And from this standpoint it is hoped that our brief review, gathered from a number of patent specifications, may be found serviceable to inventors.


No. 5
HERMETICAL SILENCER
VALVE CLOSES AFTER PASSAGE OF PROJECTILE
No. 6
DEFLECTOR VALVE CLOSES CLOSES BORE AFTER BULLET PASSES - GASES EXPAND IN CHAMBER, MUFFLING NOISE
No. 7
MUZZLE BLAST AND RECOIL
BORE FORMED WITH SERIES OF EXPANSION CHAMBERS
No. 8
MAXIM DIAPHRAGM SILENCER
No. 9
MAXIM PERFORATED DEFLECTOR
GASES ARE REVERSED FROM DIAPHRAGM TO DIAPHRAGM
MODIFICATION OF MAXIMS DEFLECTOR
MAXIM'S HOLLOW BALL MUFFLER - THE BALLS ALLOW GAS TO ESCAPE GRADUALLY
No. 10
MAXIM BALL MUFFLER ATTACHED TO RIFLE

DEVICES FOR SILENCING FIREARMS

A Proposed New Russian Patent Law

UNDER the existing Russian laws, patents are not granted for inventions of importance relating to munitions of war and to defense of the state, which can be used only by the government. For inventions and improvements relating to articles used in the army, which can also be employed by private persons, patents are granted on condition that the inventions may be used gratuitously by the government. In order to encourage inventors, a new act has been proposed, as follows:

1. Compulsory expropriation of patents for inventions and improvements for use by the government or for general use is admitted owing to circumstances of state or social necessity—but not otherwise than for a remuneration according to a fair valuation.

2. Compulsory expropriation of patents (art. 1) may be full or partial, i. e., referring only to a part of the rights in connection with a patent.

3. Compulsory expropriation of patents is allowed in each separate case by an edict of his Majesty. A draft of this edict is presented for his Majesty's opinion by the proper Minister or Director in Chief of a separate section through the Second Department of the State Council.

4. Allowance for the expropriation of patents may be requested conditionally before it is granted, but only on receipt of a certificate of protection by the inventor or his successor (art. 1987 of the Statute of Industry of 1906).

5. In extraordinary cases, urged by the requirements of the defense of the state and public safety, compulsory license of a patent may be allowed temporarily by decision of the Council of Ministers, on condition, however, that in the course of two months after such a decision the proper Minister or Director in Chief of a separate section should hand in a request in regard to the compulsory expropriation of a patent (art. 3). In the case of this request not being granted, the compulsory license of the patent is immediately stopped and its owner is notified of this fact.

6. The remuneration for the compulsory expropriation of a patent is determined either by voluntary agreement or in the manner established in the hereinafter following articles.

7. If in the course of three months from the day of presentation by the proper department, in virtue of his Majesty's edict (art. 3) or decision of the Council of Ministers (art. 5), of a demand in regard to the compulsory expropriation of a patent, a voluntary agreement concerning a remuneration for the patent which it is intended to expropriate will not come to conclusion, then, for determining the amount of this remuneration, a special committee is formed under the presidency of the Minister of Trade and Industry, the staff of which includes one member each from the Ministry of Finance and Trade and Industry, the States Control, and the department which has raised the question concerning the compulsory expropriation—if this department has no permanent representative in the valuation committee. Members of the committee are appointed by the proper Ministers and Directors in Chief of the separate sections. If the question in regard to the compulsory expropriation has been raised by the Minister of Trade and Industry, a special person is appointed to act as president of the valuation committee by Imperial order.

8. The owners of the patents which it is intended to expropriate are granted the right of presenting written as well as oral explanation to the committee, personally or through attorneys. In regard to the day when the sittings of the committees are to commence, the persons named are advised by notices, and their non-appearance on the day of the committee sitting does not stop the effecting of the valuation.

9. The committee has a right to invite experts for explaining technical questions, and also to gather the necessary information from places and persons.

10. In determining the amount of the remuneration for the patent which it is intended to expropriate, the technical qualities of the invention or improvement and those advantages are taken into consideration which the owner of the patent had reason to expect from his invention or improvement.

11. The remuneration for the compulsory expropriation of a patent may be determined by the committee in the form of a single payment of the whole amount or on the condition of paying a part of this sum immediately, while the balance of the remuneration may be dependent on the results of the tests in connection with the invention or improvement or the extent of the consumption.

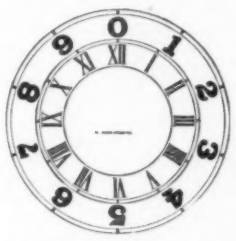
12. The decision of the committee about determining the remuneration is considered final if the owner of the patent has not handed in an appeal against the valuation of the committee within a month's term from the day he has been notified of the decision. Complaints in regard to decision of the committee should be presented by the owner of a patent within the term mentioned above through the Minister of Trade and Industry into the second department of the State Council. On examination of such cases by the department they are directed for confirmation by his Majesty in the way established for this.

13. The expenses incurred for determining the amount of the remuneration are charged to the credits from which the remuneration for the patents to be expropriated is to be paid.

In order to obtain legal force, this act must be sanctioned by the Czar, after having been voted upon by the Douma and by the Council of State. No doubt the wording of the law will be subject to some modification.

Patent Oddities.

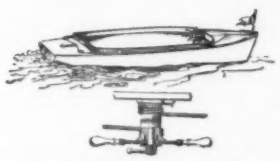
A Decimal Clock.—It is quite inconvenient, when figuring the time of workmen, to have the time expressed in hours and minutes, which is a duodecimal system, while the labor is paid for in dollars and cents, on the decimal system. This difficulty has been very simply overcome by an inventor in Louisville, Ky.,



A Decimal Clock dial.

who has fitted a clock with a face showing the ordinary twelve hour numbers, and outside of this ten divisions representing the decimal system. The time of this clock is read not in hours and minutes, but in hours and tenths of hours. For instance, a workman starting a job at 9:30 would be recorded as started at 9.5. If he completed the job at 12.3, the difference in time, namely, 2.8 hours, is evidently far more simple to calculate than it would be were it expressed in minutes.

Device for Taking Up Slack in Tiller Ropes.—The tiller ropes of small craft, such as motor boats, launches, and the like, are quite apt to stretch with use, so that the steering wheel has considerable back-lash. This makes it necessary every now and then to overhaul the steering gear and take up the slack in the ropes. To overcome this difficulty and permit of taking up the slack without any trouble whatever, a double winding drum or hub has been provided for



Device for Taking Up Slack in Tiller Ropes.

the steering wheel, the two parts of which are provided with intermeshing teeth. Normally, these teeth are kept in mesh by means of the nut that retains the steering wheel on its stud. When it is desired to take up slack in the ropes this nut is loosened, the two drum sections are moved apart, and one is turned with respect to the other until the tiller ropes are drawn taut, then the two sections are moved into engagement again, and made fast by means of the nut.

Body-supported Mirror Bracket.—The accompanying drawing illustrates a recently patented device, which should be of particular interest to those who do their own shaving. It consists in a bracket for a shaving mirror, which is so formed that it can be hooked over one's shoulders, bringing the mirror in

Body-Supported Mirror Bracket.

a convenient position for shaving. Thus equipped, one can stand in the most favorable position near a window or light. The device may be folded into a flat parcel, so that it may be packed in a trunk.

Brief Notes on Inventions

Curious Anticipations.—Many peculiar anticipations have been cited against patent applications. At one time a Congressman took to the Patent Office a lock invented by one of his rural constituents. The lock was an exact copy of a lock figured in "Price on Locks," showing the lock used on a gate of ancient Thebes thousands of years before Christ. The Congressman, after examining the illustration which was shown him by one of the officials, exclaimed that he didn't care who that fellow from Thebes was, he certainly stole it from his constituent. On another occasion an application for a patent was filed for a flower basket whose construction corresponded in detail with the scriptural description of the ark in which Moses was placed in the bulrushes, which, we are told in the second chapter of Exodus, was an ark of bulrushes daubed with slime and with pitch. This is also probably the first recorded instance of a reinforced concrete structure.

The Chinese "Yankee."—The Chinese are said to have invented spectacles as well as to have been the originators of the chief of all arts, printing, the mariner's compass, peculiar stoves, chain bridges, silver forks, India ink, chain pumps, winnowing machines and, sad to say, it is charged that instead of wooden hams originating in Connecticut, they are also monuments of Chinese ingenuity, and one writer long ago said, referring to the wooden products, "they are so adroitly constructed that numerous buyers are constantly deceived, and frequently it is not until one is boiled and ready to be eaten that it is discovered to be nothing but a large piece of wood under a hogs-skin."

A Valuable Patent.—It is rumored that in a recent consolidation of large electrical firms, the schedule of assets of an absorbed company included one patent which was valued in the transaction at $950,000.

Legal Notes

The Voluminous Expert.—The abuses of expert testimony are experienced in nearly all forms of litigation, but nowhere more than in that comprising patents. In patent suits frequently the fees of expert witnesses constitute a large portion of the expense, especially when, as sometimes occurs, one side seeks to corner all the expert witnesses, who are especially skilled in the particular art involved in the patents in suit. A well-known Pittsburg patent lawyer in conversation with the writer, in commenting on patent litigation, remarked that very few people could afford its cost. We recall hearing an attorney for one of the largest corporations of the United States, in charging delay on his opposing counsel, assert that the latter, and it was not denied, cross-examined his expert witness for twenty-eight days when, after qualifying, he was only asked one question on his direct examination. Possibly if he had been asked two direct questions, the cross-examination would still be going on. Cannot some one devise means of dispensing with expert witnesses in patent litigation and thus reduce the cost in a very material degree?

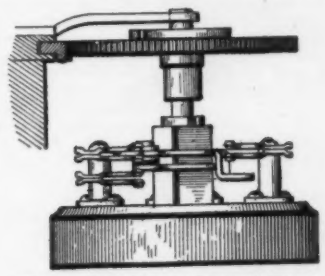
The Government and Its Inventor Employees.—The law approved on June 25th, 1910, and vesting in the Court of Claims jurisdiction of suits to recover reasonable compensation to the owner of a patent for the unauthorized use of the patented invention by the United States, contains the provision, thought by some to be unreasonable, "That the benefits of this Act shall not inure to any patentee, who, when he makes such claim, is in the employment or service of the Government of the United States; or the assignee of any such patentee; nor shall this Act apply to any device discovered or invented by such employee during the time of his employment or service."

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Electrical Devices.

ELECTRIC SWITCH.—P. T. MCNALLY, Dunlap, Iowa. The invention relates to snap-switches for electric circuits, and is so designed as to bring one or more branch circuits successively into and out of use by continuous



SNAP-SWITCH FOR ELECTRIC CIRCUITS.

rotation of the switch, or to cut off the circuits entirely. The apparatus uses high and low contacts arranged to be engaged by series of arms disposed on the switch spindle. These arms engage various contacts which are connected with the branch circuits to be controlled.

ELECTRIC IGNITER.—J. KRANNICHFELDT, Cologne, Germany. In making electric igniters or fuses for mining purposes, difficulty is encountered in rendering the same sufficiently tight to bear a high water pressure. The object of this invention is to provide means to enable electric igniters and the explosive charge to be used under water at a considerable depth or pressure, without danger of the priming or charge being spoiled.

Heating and Lighting.

VAPOR CONDENSER.—G. M. HILGER, Chicago, Ill. Among the principal objects of this invention are: to provide a structure wherein the mounting of the operative parts is simplified; to provide a structure wherein the joints and possible leakage are minimized; to provide a structure wherein is avoided the possibility of carrying over liquids by the inrushing gases; to provide means for trapping and eliminating foreign gases and atmospheric air from the apparatus.

Household Utilities.

BRACKET FOR STAIR RODS AND THE LIKE.—J. KRODER, New York, N. Y. The object in this case is to provide a bracket arranged to permit convenient opening of the bracket for the insertion or removal of the rod, or closing and locking of the bracket to prevent accidental detachment of the rod or losing any of the parts during the manipulation referred to.

JAR HOLDER.—O. F. PETERSON, Keokuk, Iowa. The object here is to provide a holder for conveniently and removably holding preserving jars and the like. To accomplish this, use is made of a frame having diametrically extending arms bound together at their central crossing and terminating in fasteners for securing the holder, the space between the arms being adapted to receive preserving jars.

WINDOW SCREEN.—H. HARRILD, Spokane, Wash. This inventor has provided a form of guide strips to be affixed to a window, whereby the screen may be arranged in a lower or upper position as desired; devices are provided to act the screen against too free a movement the guide strips. Means are provided also to permit the screen to be swung outward and to be conveniently and effectively fastened when in place.

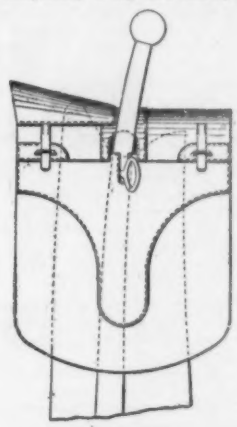
Of General Interest.

MAGAZINE PLATE HOLDER.—E. E. THRASHER, South Cumberland, Md. The invention relates to photograph, and the object is to provide a holder, arranged to enable the user to carry and use a large number of plates, to fill the same successively into a single plate holder for subsequent exposure in the camera, to allow returning the exposed plate to the magazine without requiring the use of a dark room, and permitting the user to develop the exposed plate at his convenience.

LIQUID DISTRIBUTING BRUSH.—I. D. ROCHE, Cambridge, Mass. An object of the invention is to provide a device for attachment to bottles, for evenly and automatically distributing the liquid contents of the bottle when the same is to be used on any surface, and for effectively regulating the flow of the liquid from the bottle on to the brush.

DEVICE FOR FASTENING TUGS TO HAMES.—S. J. LUTZ, El Portal, Cal. In this case the invention relates to means for securing tugs to hames, and, it has for its object to providing a fastening which may be readily used to secure to the hames the tugs, without weakening the tugs by stitching and without the necessity of depending upon tools other than those of the simplest kind.

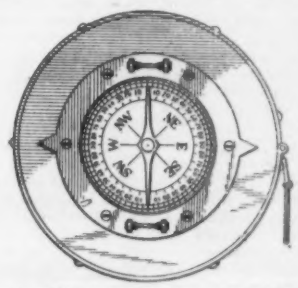
HAME-HOUSING.—T. E. BLAIR, Portland, Oregon. The invention illustrated herewith provides a housing for the hames of harness collars, comprising a cap and skirts, openings



HAME-HOUSING.

being provided to permit the hames of a collar to extend through the housing. The device is adapted for use upon draft animals, and can be applied or removed very quickly without requiring any alteration in the harness, in order to make it fit properly and without necessitating the exercise of special skill.

COMBINED COMPASS AND TAPE LINE.—A. H. WYATT, Pearl, Idaho. The device illustrated herewith may be used for certain work as a substitute for a transit, and will be found convenient for locating and laying out



COMBINED COMPASS AND TAPE LINE.

mining claims and for tracing lines in general. It consists of a casing with a compass at the top and a tape line arranged below or around the compass, the casing being further provided with sights in diametrical alignment therewith, to direct the lineman in the proper course.

Machines and Mechanical Devices.

GREASE CUP FILLER.—G. R. LA RUE, Tell City, Ind. The improvement is for use for filling the cups on machinery, with lubricant in a semi-solid or liquid form. It is more particularly an improvement in so-called "grease-guns" in which the screw that operates the slidable piston is provided with a device adapted to engage the threads of the screw and thus serve temporarily as a nut.

TYPE WRITER FOR THE BLIND.—J. C. HEATER, Joliet, Ill. The sheet of paper is placed between the sections of the ruler, and the stylus is forced against the paper through openings, from right to left, each character being formed by the proper grouping of the points. When completed the paper is reversed, and the writing may be read by passing the fingers over the embossed points from left to right. Printing must be from right to left, the reverse of the natural method.

ECCENTRIC.—R. M. CLARK, Webb City, Mo. The invention pertains more particularly to that type of eccentric which provides for the adjustment of the eccentric in respect to the shaft so as to vary the eccentricity. It relates more particularly to the type of eccentric shown in a prior patent granted to and a prior application filed by Mr. Clark.

JIB CRANE.—F. SOCHON, Vienna, Austria. The invention refers to jib cranes and has for its object to provide a crane in which not only the jib, but also the post, may be readily turned down into the horizontal position and turned up again so that the height of the entire crane when not in use is reduced to a minimum, which is of great importance in many cases.

Prime Movers and Their Accessories.

CARBURETER.—J. N. PETERSEN and W. F. PETTIT, New Orleans, La. This invention has reference to carbureters for use in connection with gasolene engines. One aim of the invention is to provide a carbureter having a cup-shaped mixture valve, having a double flat seat whereby the air and gasolene are shut off simultaneously, making it ideal for two-cycle engines, as no other check valve is needed.

MUFFLER.—J. A. CARRICK, Georgetown, Ky. This improved muffler is for use in connection with steam engines, internal combustion engines and the like, and arranged to effectively muffle

the exhaust without producing back pressure in the engine cylinder, and to prevent injury to or destruction of the muffler in case of explosion in the muffler.

TWO-CYCLE INTERNAL COMBUSTION ENGINE.—C. E. MAUD, Monterey, Cal. In this case the improvement is in two-cycle internal combustion engines of that type in which the piston serves to separate the explosion chamber and operates to compress a charge on one side of the piston during the explosion and expansion of the gases upon the opposite side of the piston.

CARBURETER.—E. F. WHITE, Atlanta, Ga. In the present invention the purpose is to provide a carbureter for positively feeding the liquid fuel, in a proper mixture, which will vary the richness of the mixture inversely with relation to the speed, and without the use of small valves.

ROTARY ENGINE.—P. GLAMZO, New York, N. Y. The various steps of this mechanism are repeated automatically over and over, so that the engine is driven continuously. In order to reverse the direction of movement of the engine, the operator grasps a handle and shifts a bar to the left. Live steam enters the engine through a tubular valve, so that the rotary parts turn in the opposite direction.

CARBURETER.—J. A. PAULL, 745 Woodbridge Road, Ipswich, Suffolk, England. In this instance the invention has reference to improvements in carbureters, the object being to provide a carbureter adapted for use with pressure feed either from an elevated tank to gravity or by spring means. A further object is to arrange the device so that it may operate in any position—inverted if desired.

Pertaining to Recreation.

COMBINATION POOL AND BILLIARD TABLE.—J. BYNER, New York, N. Y. In this patent the invention has reference to pool and billiard tables, and the object of the improvement is to produce a combination table having removable cushions which can be placed in the corners and at the side pockets, so as to transform the pool table into a billiard table.

ALARM FLOAT.—C. J. OWEN, Joplin, Ill. Mr. Owen's invention relates to alarm floats, and the aim is to provide one to be used by fishermen, which will sound an alarm when a fish is caught on a hook connected by a line with the alarm float. It is wholly needless for a fisherman to hold the line, as he may remain in the vicinity and will hear the alarm.

Railways and Their Accessories.

RAILROAD TRACK HOLDER AND BRACE.—J. T. WEST, Bowling Green, Ky. Means are provided in this invention for securing track rails on cross ties of a railroad, in a manner which will permit a release of the same when desired, and the object is to provide a device which may be readily applied for the attachment of a rail upon a cross tie; which may be quickly released therefrom, and which will reliably secure the track rail and hold it on the tie under all conditions of heat and cold.

FASTENING AND RELEASING DEVICE FOR LOGGING CAR CHAINS.—J. W. PROCTOR, Beaumont, Texas. Mr. Proctor's intention in this improvement is to provide an attachment for platform cars, or for trucks and wagons, for securing and releasing log-binding chains used thereon. It is requisite that the means employed shall be strong and simple in construction, and especially that they shall be adapted for releasing the logging chains without danger to the operator.

TORPEDO PLACER.—E. P. S. ANDREWS, West Windham, N. H. The present invention is an improvement in placers disclosed in a former Letters Patent granted to Mr. Andrews, wherein a handle bar or support has a rail shoe attached at its lower end, with a guide extended down the bar and shoe for directing the torpedoes to the rail, the guide of the handle bar preferably having a guard or casing to insure the safe transit of the torpedo.

SAFETY ATTACHMENT FOR CAR BRAKES.—J. B. WRIGHT, Greensboro, N. C. This apparatus is for use in automatically operating the brakes of a railway train in case of accident to the trucks, or from any other cause which tends to throw them into an abnormal position. Intermittent action of a novel valve causes the brakes to act gradually on the wheels, so as to bring the train to a gradual stop.

SWITCH-LOCK.—C. MCGILL and A. R. HIGGINBOTHAM, Red House Shoals, W. Va. The main purpose here is to provide means by which the switch lever may be automatically locked by the mere act of throwing the switch. The lock has a peculiar form of key, simple, but one not readily made, as are keys cut from blanks, and which, therefore, is not likely to be duplicated by vandals or mischievous boys, or others, who wish to throw the switch at times when the change of the switch might result in disaster to trains.

TRAIN-PIPE COUPLING.—H. O. WITWER, Lethbridge, Alberta, Canada. The object of the inventor is to provide an automatic coupling, arranged to insure an automatic coupling of the train pipes of two cars coming together, to cut off the fluid pressure in the pipes on the cars being uncoupled, and to cause an emergency application of the fluid pressure brakes in case the cars accidentally break apart.

CAR-COUPLING.—H. C. CRIGGER, Johnson City, Tenn. This invention relates to couplers of the Janney type, and is especially intended as an improvement upon a coupling previously patented by Mr. Crigger. The invention forming the subject of the present patent consists of improved devices for shifting the knuckle from the side of the car in coupling and uncoupling and for retaining it in the adjusted position until required to be moved.

AUTOMATIC COUPLING FOR CARS AND CARRIAGES.—L. BOIRAULT, 8 Rue Emile Gilbert, Paris, France. The present invention relates to improvements in automatic couplings for cars, particularly of the kind made known by a prior American patent granted to Mr. Boirault. The present invention has for its object to construct a coupling head of such a special shape that the dimensions of the head including its guiding surfaces can be considerably reduced and that the solidity of the said parts can be considerably increased.

CAR-BRAKE EQUALIZER.—H. L. BLUNCK, Sioux City, Iowa. In the ordinary brake attachment of four-wheeled car-trucks, the brake action is not duly equalized on the respective trucks. The inventor has devised an improvement which is simple in construction and effective in use and which constitutes an addition to the ordinary brake attachment and whereby the action of the brakes of both trucks is equalized.

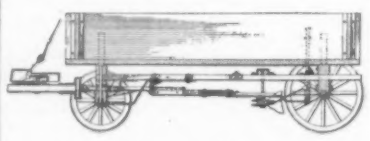
DRAFT-EXCITER FOR LOCOMOTIVES.—A. L. BRIDGHAM, Boston, Mass. This improvement provides an apparatus disposed in a roundhouse for accelerating the draft in locomotives for limiting the time for starting the fire; provides means whereby an apparatus may be installed in operative position and raised therefrom; and provides means whereby the apparatus may be maintained in elevated position to provide the needed head room in the roundhouse.

Pertaining to Vehicles.

SPRING-WHEEL.—Z. A. BRUEGGER and R. D. BRUEGGER, Culbertson, Mont. This invention relates to spring wheels to be employed as substitutes for pneumatic wheels in motor cars and other vehicles. It discloses a distinctive form and arrangement of elliptical spring as well as special features entering into the construction of the body of the wheel and rim structure and the housing place.

WAGON LOADER.—A. MCKINNEY, Berclair, Texas. The invention is an improvement in loading devices for wagons and has for an object, among others, to provide a construction of loader which will include a weighing means all being constructed so the material being loaded into the wagon may be weighed when supported from the loading devices and then conveniently delivered into the wagon or other receptacle.

WAGON BRAKE.—EBEN G. DOLAND, Starksboro, Vermont. The invention which is illustrated in the accompanying engraving provides an improvement in brakes for wagons and other vehicles. The brake arrangement is used



AUTOMATIC WAGON BRAKE.

to lock automatically with the shoes either applied or released, by a predetermined pull and backing of the wagon tongue respectively, and it is adapted to be manually unlocked and locked, whereby the brakes are freely applied and released under the action of the tongue.

Pertaining to Vehicles.

WAGON BRAKES.—J. W. FINCH, Bentonia, Miss. The intention in this case is to provide an efficient brake, connected directly to the axle and supported entirely by the running gear, so that the bed may be removed without affecting the brake, and wherein all of the brake mechanism is outside of the load line, and the capacity of the wagon will not be decreased.

Designs.

DESIGN FOR A MONUMENT.—E. O. TOWNSEND, New York, N. Y. In this ornamental design the shaft is placed on a rough surfaced base. The former is two-thirds the height of the monument, is rough surfaced on the ends, and is smooth faced in front. An urn with flowers stands in front of the shaft on an edge of the base and to the right of the urn are polished black tablets for name and inscription.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

The weekly *Index of Patents* issued by the *United States Patent Office* will be found in the *Scientific American Supplement*.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12357) H. B. M. asks: Do you know of an appliance that can be applied to a chimney, say 50 feet high, to consume the smoke? The Endaly kiln has a down draught, and is used for burning paving brick. It is for the chimney of this kiln that I would like to know if the smoke nuisance can be overcome in any way. A. There is no form of carbon more difficult to burn than smoke, once it is formed. In boiler furnaces combustion can be carried on by proper air supply, so that no smoke is formed, but in some drying and roasting processes there are conditions which prevent giving proper air supply, and smoke is inevitable. Once smoke is allowed to form, it can only be removed by washing the flue gases by water sprays. As this process destroys the draft by cooling the gases, a fan or blower must be provided to force the flue gases up the chimney after the smoke is washed out.

(12358) A. A. S. asks: Our village water main shows a pressure of 75 pounds. I have a 3/4-inch pipe 75 feet long straight into my cellar. Is there enough power to this strain, if rightly applied, to operate a suction cleaning hose? Could the air be exhausted from the hose by the "jet pump" principle? A. Your pipe is probably large enough. A vacuum cleaner working by water jet was described fully in SCIENTIFIC AMERICAN, No. 19, vol. 99, page 320, and No. 2, vol. 100, page 29, which we can supply at ten cents each mailed. We hear that someone has recently tried a short piece of soft rubber tube as an outlet, in place of the 30-foot vertical drop leg, and found that it collapses against the stream so as to act as a check and prevent the air from returning against the stream.

(12359) J. B. McD. asks: Is there any limit to the pressure that air will receive? Can ether be compressed, as if you were pumping ether from one vacuum into another vacuum? A. There is no limit to the compressibility of air at the ordinary temperature. It must be cooled 220 deg. F. below zero before it can be liquefied by pressure, and then will require 39 atmospheres for liquefaction. If colder than 312.6 deg. F. below zero, it will remain a liquid at atmospheric pressure. The ether of space cannot be confined by any ordinary vessels, since it passes freely through all known bodies as if they had no existence.

(12360) J. M. G. asks: Could a barrel of water be prevented from freezing if placed inside a box surrounded by sawdust? A. Yes; for a limited time. No matter how good you make your protecting casing, the heat of the water will gradually pass through it when the outside temperature is lower than the temperature in the barrel. If the weather stays cold long enough, the barrel will surely freeze in time, but how long the time will be can only be determined by trying it.

(12361) S. T. asks: Will you kindly answer the following questions: Whether, in a wire connected to battery or other source of current, the current remains in the wire after the circuit is broken ready to assume its flow, or whether it comes from the battery when the circuit is closed? A. The electric current does not remain in the wire after the circuit is broken, ready to start when the circuit is closed again. Current only exists while it is flowing over the circuit. The electromotive force, or pressure, as it is more commonly called by electricians, is the cause of current in a circuit, and that still exists whether a current is flowing or not. The battery or dynamo produces volts or electromotive force. The materials and wires have resistance to the flow of an electric current. The resulting current in any case is determined by the relation of these two, the volts and the ohms. When the circuit is broken, the resistance becomes so great that no current can flow. If the voltage were high enough, the current would be forced over the gap of the switch and make an arc. Then there is current flowing over the gap. Current is always the result of sufficient electromotive force to push the electricity through any place or resistance.

(12362) W. A. M. says: Will you kindly let me know if there is any difference in a German and an American horse-power? A. Only two "horse-powers" are recognized in engineering: the unit of 33,000 foot-pounds per minute and the unit of 4,500 kilogrammeters per minute, which is 32,549 foot-pounds, and is known as the metric or French horse-power. As Germany is a metric-system country, the metric horse-power is probably used in any German calculations which you have in mind.

NEW BOOKS, ETC.

CHATS ON ELECTRICITY. By Frank Broadbent. Philadelphia: J. B. Lippincott Company. 196 pp. Price, $1.25 net.

The object of this book is to explain to the non-technical man in simple language how electricity is used in the home, in the factory, for lighting purposes, telephones, telegraphy, wireless telegraphy, etc. There is an introductory chapter taking up the question of what we know about electricity, its characteristic properties, and the sources from which it is obtained. The author has avoided going into any detail in explaining various electrical apparatus, and yet he has furnished sufficient information on the subjects to enable a non-technical man to gain a general understanding of matters electrical.

TELEGRAPHY FOR BEGINNERS. The Standard Method. By Willis H. Jones. New York: Spon & Chamberlain, 1910. 57 pp. Price, 50 cents.

The author, who is Wire Chief of the Western Union Telegraph Company, has written this book with a view to establishing a standard method in place of the "go as you please" method that has hitherto existed among operators instructed by different teachers. The book takes up the study of the Morse alphabet and other characters, together with signals and various abbreviations, also the best methods of telegraphing sporting events, market reports, etc., in tabulated form. A student's outfit and practice circuit is described, and there is a chapter on "How to Adjust a Sounder."

MAGNETS AND MAGNETISM SIMPLY EXPLAINED. By Alfred W. Marshall. New York: Spon & Chamberlain Co., 1910. 90 pp.; 49 illustrations. Price, paper, 25 cents.

The object of this book is not to give rules for calculating magnets, but merely to explain the principles of magnets and magnetism. It takes up permanent magnets as well as electromagnets, and gives experiments with magnets and solenoids. The book is quite elementary, and written in simple language.

THE UNITY OF THE UNIVERSE. By Joseph Cosand. Tokyo: The Methodist Publishing House, 1910. 376 pp.

In the effort to bridge the apparent gulf between science and religion, the author has made a collection of scientific and religious facts, putting them together in such a manner as to show the unity of the physical and spiritual universe.

WIRELESS TELEGRAPH CONSTRUCTION FOR AMATEURS. By Alfred Powell Morgan. New York: D. Van Nostrand Company, 1910. 188 pp.; 147 illustrations. Price, $1.50.

The directions given in this work are very practical and well within the abilities of the average amateur worker. The author's experience as editor of the mechanical and electrical departments of the Boys' Magazine has enabled him to deal with the subject of wireless telegraphy in a manner suitable to the requirements of beginners. The theory of wireless telegraphy is briefly explained by using the analogy of a "hydraulic transmitter and receptor," but the explanation is made without recourse to mathematics. Directions are given for making all the necessary apparatus, including coils from one-half inch spark length to six inches, and transformers by which line current may be utilized.

THE SPEED AND POWER OF SHIPS. A Manual of Marine Propulsion. By D. W. Taylor, E.D., Naval Constructor U. S. N., Vice-President Society of Naval Architects and Marine Engineers, Member Institution of Naval Architects. New York: John Wiley & Sons, 1910. Vol. I. Text 8vo.; vi 314 pp. Vol. II. 120 tables and plates, 4to.; 2 vols. Cloth, $7.50 net.

The author of this work is not only the leading authority in the United States on model tank experiments, but his work has received the highest indorsement of the naval constructors of Europe. The intention of the book is to treat in a consistent and connected manner, for the use of students, the theory of resistance and propulsion of vessels and to give methods, rules, and formulæ which may be applied in practice by those who have to deal with such matters. The contents are based largely upon model experiments, such as were initiated in England nearly half a century ago by Mr. William Froude, and are now generally recognized as our most effective means of investigation in the field of resistance and propulsion. At the same time care has been taken to point out the limitations of the model experiment method and the regions where it ceases to be a reliable guide. The science of naval architecture is not yet developed to a point where our knowledge of resistance and propulsion is complete. While the author naturally hopes that this volume will at least partially bridge some of the gaps hitherto existing, much work remains to be done, and in a number of places attention is called to the need of further investigation of various questions.

VIBRATIONS OF SYSTEMS HAVING ONE DEGREE OF FREEDOM. By B. Hopkinson, M.A. London: Cambridge University Press, 1910. Price, $1.

A Nantucket Windmill of 1746

(*Continued from page 84.*)

forms the actual grinding, the meal pouring into a hopper on the floor below.

The grinding shaft is another novel feature of the mill. As already stated, nearly all the material of which it was constructed was "home-made," but even oak was not strong enough to revolve the granite grindstone, as it is a foot thick and six feet in diameter, with a hole for the driving shaft only four inches square. Wilbur solved this problem by making a combination shaft. He had a bar of iron forged in England, of the length required and of a width that would exactly fit the hole in the stone. He set this through the stone, the lower end being buried in the ground beneath the mill, thus anchoring the shaft. Above the grindstone the iron was fastened to the wooden shaft by clamping the ends together with a heavy iron "collar" or band.

The method of applying the power generated by the wind wheel, and the spar and capstan system, are as interesting as the way in which the grindstone is turned. The operation of the spar has already been explained. The cog principle is again used, however, in its connection with the mill. The upper end of the spar, which projects into the mill, is connected in this way with the hub of the wheel, and as the spar is turned by the capstan, this aids in keeping the wheel in motion. The shaft of the wind wheel framework extends to the center of the driving wheel, and turning by the action of the wheel as driven by the wind, communicates power to the grinding machinery in this way.

As it is necessary to control the force of the wind at times when the velocity is too great, and the wheel might be damaged by turning too rapidly, the builder of the mill designed a crude brake which counteracts the force of the wind and controls the speed of the wind wheel when necessary. It consists of a heavy oak beam, to one end of which a box of stone weighing several hundred pounds is attached by a rope and a pulley. One man can raise and lower the box, so carefully is the weight adjusted. The end of the beam projects under the shaft extending from the hub of the wind wheel into the mill. It is held loosely in a rope noose, and when it is necessary to check the speed, the box of stone is loosened and the weight presses down. On the principle of the seesaw, the other end moves up and presses against the wind-wheel shaft. This brake is also used to stop the wind wheel at night, or when operations are suspended.

The capacity of this mill is ten bushels an hour when operated at its greatest speed. But one man is necessary to perform the operations. The arrangement about grinding corn is a custom handed down from the older days. Farmers bring the grain to the mill, and when it is converted into meal and weighed, each farmer gives the miller three quarts out of every bushel of grain which is ground, or about ten per cent.

Two New French Aeroplanes

(*Continued from page 85.*)

verse stability due to the zig-zag girders which resemble the tetrahedral cell—the most stable form of supporting surface; and (5) ease of assembling and disassembling of the machine.

In view of the supporting power and stabilizing effect of the trussed girders it is interesting to note that supposing the machine to fly at a speed of 45 miles an hour with the cloth on, if this were removed the girders themselves would theoretically support the 800 pounds at a speed of 120 miles per hour. If it were possible to reef the cloth of the wings while in flight, it would therefore be possible to keep diminishing the supporting surface until this consisted of simply the girders alone, while the speed of the aeroplane would constantly increase to 120 miles an hour or more.

Some two or three years ago Santos Dumont constructed a small biplane having its supporting surfaces set at a sharp dihedral angle. Wood was used for the aeroplane surfaces, and it was thought that this machine would be very speedy. The supporting surface was so small in proportion to the weight that it was difficult to attain sufficient speed for a sustained flight, and almost at the first attempt the machine was smashed and abandoned by the daring Brazilian. The Paulhan biplane with reefed wings would be a direct descendant of Santos Dumont's wood-surfaced flier, and the possibilities of the latter machine flying under bare poles, so to speak, give one an idea of the size and speed of the aeroplanes that will undoubtedly be developed in the future.

Mimicry with the Mimic Left Out

(*Continued from page 87.*)

and sucks out the juices. It has been suggested that the monkeys might be the destroying angels who weed out the "unfit" that do not come up to the standard of appearance; but in northern Ceylon, where the monkeys are most abundant, the form of these butterflies that is most abundant is the supposedly "unprotected" one; whereas the protected forms—the "mimics"—occur where the monkeys are scarce.

One particular group that Prof. Punnett worked with was the genus *Papilio*. One species, *P. polytes*, has three distinct kinds of females: one of these resembles the male, and of the others each resembles a distinct species of *Papilio*—one *P. hector*, and the other *P. aristolochiæ*. The two latter species are supposed to be the "models," on account of their poisonous or disagreeable juices and their more brilliant coloration.

In these, as in other cases of resembling pairs examined, the resemblance is most striking when the specimens are prepared (as they are in collections and museums) with the wings spread out showing only the upper surfaces, and generally concealing the bodies. In their natural surroundings, and especially while on the wing, the resemblance is much less; and Prof. Punnett was able, after a short stay on the island, to recognize any of the species that he studied at a distance of from ten to fifty yards, by the appearance during flight. It is highly probable, he thinks, that any of the supposed enemies, brought up among these insects, should have no more difficulty in discriminating between the different species; especially since, according to the doctrine of natural selection, the very existence of the enemy would depend upon recognizable suitable material when he sees it.

Some of the difficulties of the "natural selection" theory for explaining the origin of three distinct forms of females in this species, or, for that matter, in any species—and there are many—that shows females of two or more forms are:

1. Slight variations from the original pattern must be supposed to have sufficient protective value to determine that the individuals possessing the particular pattern variation in question should survive in larger proportions than the original forms.

2. There are no intermediate forms, such as we should expect to find if the new forms arose gradually through the accumulation of minute differences.

3. The frequent absence of the "protective" mimicry among the males.

4. There are many species of insects that have two or more forms of the female, without any particular mimicry, or other discoverable advantage.

5. It is assumed that minute variations of all sorts can be inherited; this has not been demonstrated.

Prof. Punnett suggests an explanation for these "mimicking" females that is

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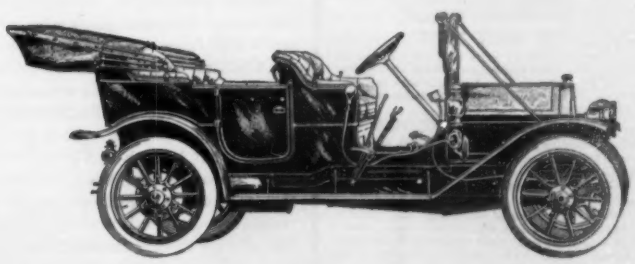

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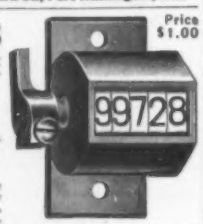

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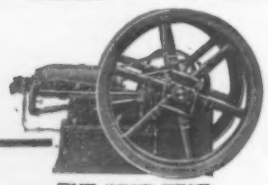

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more in accord with what we now know of the laws of heredity. If we suppose that the divergent types of females arose as sudden "mutations" or *sports* from the original type, it is easy to construct a scheme of the hypothetical constitution of such individuals, from the point of view of heritable qualities, which would show not only how the new female characters would be continued in accordance with well-known Mendelian laws, but also how the original form of the female—that resembling the male—would be eliminated in the course of time. To be sure, such a scheme, being purely hypothetical, proves nothing and must be subjected to the test of experiment, which takes time. But experiments already made in the breeding of insects—some by E. B. Poulton, the most aggressive defender of the natural selection theory as applied to mimicry—are not in conflict with Punnett's theory.

If there should arise by mutation a form that was incapable of maintaining itself under the conditions of its environment, this form would of course be eliminated by the action of natural selection. But under the circumstances Prof. Punnett considers all that is required is that a mutation shall not have any characters that are harmful; it is possible to look upon the existence of the various forms as due to the *absence* of "natural selection" or any adverse conditions rather than to the operation of natural selection. In other words, natural selection may play a part in the *conservation* of new forms, but can have nothing to do with their *origin*.

Metals More Precious than Gold

(*Continued from page 88.*)

hard, and are used for pointing pens. Metallic iridium possesses a white, steel-like appearance. The knife edges of delicate balances and other bearings that require extreme hardness are often made of it. An alloy of ten per cent iridium and ninety per cent platinum has been found to be little affected in volume by changes of temperature, and is the substance of which the standard meter, kept in the International Metric Bureau at Paris, is made.

Rhodium and ruthenium are metals of comparatively little practical use. The former occurs in platinum ore to the extent of five per cent. The latter is found only in osmiridium, and averages about five per cent of that metal.

The six metals mentioned are generally treated of together because of their resemblance to one another.

The metal that really ranks next to platinum in value is zirconium, which occurs in hyacinth and some other rare minerals. Titanium and uranium, whose ores are found in Cornwall, England, and some other places, are slightly more costly than zirconium. Uranium is remarkable for its high atomic weight.

Another costly metal is lithium. Its salts are widely distributed, being found in very minute quantities in the ashes of many plants, especially tobacco.

Vanadium, the ores of which are also very widely distributed, occurs, according to one authority, in all primitive granite rocks, but in small quantity. It is difficult to obtain in a state of purity, and is of value in processes connected with the manufacture of steel.

The next metal is barium, concerning the appearance and properties of which much difference exists among chemists.

Rubidium and cæsium were the first of a number of elements whose discovery was directly due to the introduction of spectroscopic analysis. They are widely diffused, but in such small quantities that their presence has been undetected by the methods of analysis previously in use. One mineral spring in Cornwall was shown to contain about one and one-half parts of cæsium in one million. A similar spring in Durkheim, Bavaria, contains one and one-half parts in ten millions, and these have been regarded as the richest sources of cæsium until recently, when both it and rubidium were found in Vulcano, one of the Lipari Isles. Rubidium occurs as silver-white globules of metal. Cæsium is also of a silver-white color, and is soft at ordinary temperatures.

Another metal whose discovery is due to the spectroscope is gallium. It is bluish-white in appearance, and is easily fused. In fact, it can be liquefied by rolling it between the fingers. When rubbed on glass it forms a mirror much superior to the ordinary mercurial one.

Next may be mentioned a group of fifteen metals, usually known from their analogy to the most important of their number as the cerium metals, many of which are extremely rare and valuable. They are cerium, yttrium, lanthanum, præseodymium, neodymium, terbium, ytterbium, erbium, holmium, thulium, dysprosium, decipium, samarium, scandium, and victorium. The cerium metals are chiefly associated in groups in minerals that occur in Sweden, Greenland, and some parts of Siberia. Three metals that sometimes accompany them are thorium, niobium, and tantalum; but they are not classified with them because of the dissimilarity of their properties. These metals do not occur in commerce to any extent, with the notable exception of tantalum, which has been utilized in the manufacture of electric lamp filaments. Generally speaking, the cerium metals may be held to be mere chemical curiosities.

Within recent years the most notable additions to the catalogue of metallic elements are radium, actinium, and polonium, whose existence remained unsuspected until science began to experiment with the Röntgen and Becquerel rays. So much has been written of these, that it were superfluous to treat of them, especially radium.

American Aborigines

(*Continued from page 89.*)

stature, yet possessing remarkable strength and endurance. Their skin is a light brownish yellow with a ruddy tint on the exposed parts. Their hands and feet are small and well formed. Their eyes resemble those of the Mongols, and this fact has induced many students to classify them with Asiatic peoples.

Among most Eskimo tribes the women tattoo their faces, and some of the Alaskan tribes wear studs in openings through their cheeks. To a certain extent the Eskimos practise both polygamy and polyandry, but a second marriage is unusual where children have been born of the first wife. Their religious cult is curious. They believe in spirits inhabiting animals and inanimate objects, but their chief deity is an old woman who is said to reside in the ocean and has the power of wreaking vengeance on her mortal subjects by causing storms to arise, etc., if any of her laws are infringed. The central tribes believe that a man's body is inhabited by two spirits, one of which stays with it when it dies and may temporarily enter the body of some child, who is then named after the deceased, while the other spirit wings its flight to one of the many lands reserved for the souls of the departed.

Groups of North Greenland Eskimo (Smith Sound) and western (Alaskan) Eskimo are here illustrated.

The first depicts a phase of family life at Smith Sound as it might appear in the spring, moving across the ice fields. The young man, having clubbed a small seal, has called on the sledge party to haul it home. He is laughed at by the elder man, who doubtless asked him jokingly why he couldn't have carried it home on his back. The fact that they were unnecessarily called out to perform the task of bringing this little seal home on a sledge did not irritate them; for, strange as it may seem, these people, living farther north than any other tribe, isolated from everything that we regard as making life pleasant and comfortable, are exceptionally cheerful. The woman, who carries a baby in her hood, is about to help in attaching the seal to the sledge. A girl is playing with the dogs, while a little boy is seen clinging to the back of the sledge.

The second picture shows the typical western Eskimos, who inhabit the shores of the northwestern seas from the mouth of the Mackenzie River around Alaska to Mount St. Elias. The woman with a child is dressed in caribou skins, while the one on the right, from Bristol Bay, is clad in marmot skins. The man, from the region of Norton Sound, is dressed in caribou and holds a barbed harpoon in his hand.

We now take quite a jump, from Eskimo land to the Great Plains, where live the Sioux, Algonkin, and Kiowa tribes.

In taking this leap we pass over, with only a sentence or two, the Chilkat Indians of southeastern Alaska and the Hupa Indians of northwestern California, as it is impossible to notice every type in a brief article of this kind. The former do commerce with the Athapascan tribes to their east, from whom they obtain the horns and wool of the Arctic goat. The women weave the wool into the famous Chilkat blankets, the designs of which are inserted separately, as in the Gobelin tapestry. The Hupa Indians live on a mixed diet of meat, fish, and acorns; they dress in deerskins and are very fond of personal adornment. One of their most important industries is the harvesting, transporting, storing, and milling of acorns, as well as the preparation of food from the meal.

The next picture shows a Sioux family, whose activities depended largely on the buffalo, from which were derived their food, dress, tents, tools, and even their folk-lore and religion. In this picture is seen a man returning from the chase; his wife is dressing a hide; the young girl is beading a moccasin for her sister, while the small boy, with a bow and arrow, is toddling forward to welcome his father.

In the Pueblo province the Navahos are conspicuous. They are especially interesting, since it was under Spanish direction that they laid aside their wild hunting habits and became herdsmen of sheep and other domestic animals, and learned to weave and work in metals. A man may busy himself with implements of iron, shaping some silver ornaments, which they are very skillful in working. The women engage in their most notable industry, i. e., spinning yarn from native wool and weaving blankets. As intimated, the Navahos have become adept in various industrial occupations. An interesting account of their work in tanning and shoe making was published in Volume XI. of the Proceedings of the National Museum, while their skill in belt weaving is described in Volume XIV. of that series, and their advance in house-building methods is the subject of an article in Volume XV.

We next come to the Zuñi Indians, who live in pueblos on the tablelands of western New Mexico. They were visited at the beginning of the sixteenth century by the earliest Spanish explorers, and their arts and industries, religion, etc., were critically studied some years ago by Mr. Cushing and Major Stevenson of the Bureau of American Ethnology. Later, Mrs. M. E. Stevenson has continued these studies, and a number of excellent papers on this tribe, by these investigators, have been published in Volumes II., III., IV., V., XII., and XVIII. of the Reports of the Bureau of American Ethnology. A group not represented here includes in the foreground a young woman engaged in weaving an artistic belt. At the right is seen an old man drilling a bit of stone with a pump-drill. His costume is that worn during the Spanish period. Near the middle of the group stands a

young girl, just returned from the spring and bearing a water vessel on her head. The children are eating, the older one raising her hand to receive a bowl from her elder sister.

With the above group we leave the United States and take up for a hasty sketch the Indians of Mexico, who are represented in the next picture by a group of Cocopa Indians, of the Sonoran ethnic province. They occupy the lower valley of the Colorado River in Mexico from the international boundary to the head of the Gulf of California. They were visited by the Spaniards as early as 1540, but retained their primitive characteristics up to about 1890. They subsist largely by means of agriculture, feeding partly on game and fish, with various seeds, fruits, and roots. They dwell in scattered settlements, usually containing from one to about six houses. They wear but little clothing, the men until recent years using only skins, while the women dress in petticoats made from the inner bark of the willow. They habitually paint their faces, and are also tattooed to a moderate extent. In the picture is seen a young man with bow and arrow engaged in teaching a boy to shoot. The woman is pounding corn in a wooden mortar, while the young girl carries the baby and is evidently interested in her brother's lesson in shooting.

Again traveling south we reach the Maya-Quiché tribes of Indians in Guatemala. They also occupy parts of Chiapas and a small part of western Honduras. These Indians were at one time the most highly cultured of all the native peoples of the Western Hemisphere. They dressed in delicate fabrics, built huge terraces, and stepped pyramids surmounted by buildings adorned with sculptures and paintings. They were distinctly an industrial and artistic people. Their paintings and sculptures treat of religious subjects, and are remarkably free from scenes of blood and slaughter. At the present time there are several hundreds of thousands of these interesting Indians in Central America. The family group here shown includes a man with his staff, bearing a net filled with fruit, a woman working at the mill, another woman carrying a basket of fruit in her right hand and a gourd bowl in the left, while the girl walks by her mother, holding a decorated gourd vessel of globular shape.

Another interesting group of Mexican and South American Indians follows. It consists of three figures, a woman from Oaxaca, in southern Mexico, and two men representing the Piro and Jivaro tribes of the headwaters of the Amazon. The woman is dressed in a skirt of striped native-woven cloth. The upper part of her body is covered with a tastefully decorated tunic and her head is protected by a long sash or "velozo." In her left hand is a red earthen drinking cup, while in her right are two gourd vessels. The man on the right is a Piro of the Arawakan family, which is of special interest because tribes speaking the same language were met with by Columbus on his first voyage to America. The man at the left belongs to the Jivaros, who live on the headwaters of the river Marañon. His feather skirt and head dress are tasteful and brilliant, ornamented with teeth, beetle wings, and seeds. The elegance of his costume hardly comports with the fierceness of his nature, for this is one of the most aggressive of all Indian tribes in South America. They are the famous head-hunters, and one of their horrible customs is to preserve the dried heads of their enemies.

The last picture shows a group of the Tehuelche Indians. They live on the plains and desert areas of the southern part of Patagonia. They dress in the skins of animals, make their tents or "toldos" from the hides of the same animals, and live on animal food. They are tall and athletic like the Plains Indians of the United States. They hunt the guanaco, the American ostrich, and other animals on horseback. The group shows a family just breaking camp. The man, wearing a robe of skunk-skin, with bolas in his hand, is ready to mount his horse. One woman has already mounted, and the boy is assisting in completing her outfit. The second woman is rolling up skin robes of the household, while the little girl is haltering the pet ostrich, the baby meanwhile sleeping in its cage-like cradle.

A New Metal for Aeroplane Construction

From Our English Correspondent

One of the chief chemists in the laboratory of Messrs. Vickers, Sons & Maxim, the well-known British armament manufacturers, has recently perfected an aluminium-alloy which has the strength of mild steel, and which is only slightly heavier than aluminium. This new alloy, to which the generic name "Duralumin" has been applied, is especially suitable for the frames of aeroplanes and the cars of dirigible balloons, where combined lightness, great strength and toughness are so imperative; and inasmuch as this firm is now actively engaged in the construction of aerial vessels, it is being extensively utilized in connection therewith. The alloy contains upward of 90 per cent of aluminium, has a specific gravity of about 2.8, and a melting point of 650 deg. C. (1,202 deg. F.). Its physical properties are secured by special treatment which is well under control, and may be obtained for any purpose for which it may be required with a tensile strength of 40 tons per square inch with very little elongation, from 28 to 30 tons per square inch with 15 per cent elongation in 2 inches, or 25 tons per square inch with an elongation of about 20 per cent in 2 inches. Although primarily evolved for the rigid parts of aerial vessels, it has been found that the alloy is eminently suited for the fabrication of any article usually executed in aluminium, either for military, domestic, or commercial purposes where a great economy in weight is of vital importance. The alloy will also take a polish equal to nickel plating, is unaffected by mercury, and is non-magnetic, while it is proof against atmospheric influences and but slightly susceptible to the action of sea or fresh water. For electrical apparatus it possesses many possibilities, emits when struck a clear silver tone, and is suitable for sound producing apparatus such as bells, organ pipes, etc. The alloy is obtainable in its finished form for whatever purpose it may be required such as rivets, plates, sheets, wire, strip, and so on, but is not recommended for castings. The Vickers, Sons & Maxim Company has erected a special factory near Birmingham for its production, which has been placed in the hands of one of its subsidiary connections, the Electric and Ordnance Accessories Company.

Tortoise Shell

The finest of tortoise shell is said to be that which comes from the Indian Archipelago, although much of that obtained on the Florida coast is of the very best quality. There are three rows of plates on the back of the animal, called "blades" by the fishermen. In the central row are five plates, and in each of the others four plates, the latter containing the best material. Besides these, there are twenty-five small plates round the edges of the shell, known as "feet" or "noses." The biggest turtle does not furnish more than sixteen pounds of shell. Formerly the undershell was discarded as worthless, but now it is much esteemed for its delicacy of coloring. Sometimes imitation of tortoise shell is made of the horns of cows.

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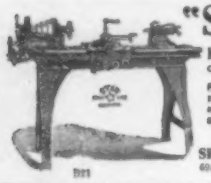

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Electricity

The Water Power of Canada.—An official estimate of the water power in Canada places the total horse-power capable of being developed at 25,000,000. Of this, the Province of Quebec owns the largest amount, namely, 17,000,000 horse-power. The actual horse-power developed in this province, however, is but 50,000. Ontario, on the other hand, has 3,000,000 available horse-power, and is developing 330,000 horse-power.

Hydro-electric Development in Maine.—Plans are on foot to build a large hydro-electric plant on the Kennebec River at Moosehead Lake. The ultimate capacity of the plant will probably be 100,000 horse-power. The power thus produced will be employed for manufacturing and lighting purposes within the State of Maine. The company owns the rights between Moosehead Lake and The Forks.

Wireless Combination in Germany.—All the different wireless companies of Germany, as well as the Belgian Wireless Company of Brussels, have combined and formed what is known as the "German Operating Company for Wireless Telegraphy." The Telefunken and Braun patents belong to this organization. Stations on the North German Lloyd, Hamburg American, and other German lines have heretofore been operated by the Marconi and Telefunken companies jointly, but now they will be in the hands of the new organization, because of the Marconi rights owned by the Belgian company.

Weight of Car Motors.—Most of the power consumed by an electric car is employed in accelerating or getting itself under way, and as such work increases directly in proportion to the weight of the car, it is quite essential that all unnecessary weights be reduced. For this reason considerable attention is being paid at present to the designing of car bodies in such a way as to reduce the weight to a minimum. The weight of the motors is also being investigated. The *Electric Railway Journal* in a recent comment on this subject, pointed to the advantage of using commutating pole motors and the necessity for better insulation with an artificial means of ventilation. It also called attention to the use in Germany of aluminium in place of copper for the field coils. Another method of reducing the weight consists in using higher armature speeds with double-reduction gearing.

Neon Vacuum Tubes.—Neon appears to give remarkable results when used for vacuum tubes for lighting purposes. The rarefied gas produces a strong light, as is brought out by M. Georges Claude. However, it is very difficult to prepare such tubes, as neon loses its effect when in presence of a small amount of other gas. Thus a small per cent of nitrogen lowers the light quite appreciably, so that he cannot simply introduce even pure neon into a vacuum tube, for the gases given off by the electrodes and the sides of the tube when the current passes will cut down the light almost entirely. To overcome this, he uses Dr. Dewar's principle of absorbing by carbon at a very low temperature. Carbon is placed in bulbs connected to the tube and kept very cold so that all the gases are absorbed but the neon and a little hydrogen. It often requires a long treatment to thus "form" the tube, and finally a fine orange-colored light due to the neon appears. The carbon bulbs can then be removed. The light from the neon tube is very strong and contains a large amount of red rays, being thus the opposite of a mercury-vapor tube. He uses a tube with a twenty-foot distance between electrodes and two inches diameter. Only 1,000 volts is needed, compared with 3,000 volts for a nitrogen tube. It gave 1,320 total candle power, consuming 850 watts or 0.64 watts per candle power. No doubt this value will fall much lower after experiments.

Engineering

State Barge Canal Quantities.—At the close of last year, 41,000,000 cubic yards of excavation had been done on the New York State Barge Canal, and 1,100,000 cubic yards of concrete had been laid. Each of these quantities is about 40 per cent of the total amount required for the finished project.

Thermit Rail Welding.—The Holyoke Street Railway Company has done some successful thermit welding, which it is believed will provide the much desired absolutely continuous rail. The rail ends, spaced ¾ inch apart, are first heated to a red heat, when the molten steel resulting from the thermit reaction, is poured into the mold. The surplus metal about the rail is removed, and the joint surfaced off by means of a grinder.

Dangers of Railroad Trespassing.—Since January 1, 1900, trespassing on the Pennsylvania Railroad in violation of the law has caused the deaths of 7,966 people, an approximate rate of two each day. As the result the company's efforts to educate the public to the dangers of trespassing, the number of trespassers killed was reduced from 916 in 1907 to 743 in 1908, to 633 in 1909, and to 585 in 1910, a reduction of 30 per cent in four years.

To Prevent Defilement of Harbors.—Captain Winslow, U. S. N., supervisor of the harbor of New York, in his annual report, proposes to prevent the defilement of the harbor by floating and unsanitary debris by the use of a deck scow, which will prevent the escape of light rubbish as it is being towed out to sea. He also proposes stricter supervision of scow masters who go to sea in rough weather and, to save their craft, dump the load wherever they may chance to be.

Water Tanks to Prevent Rolling.—Kaiser Wilhelm has congratulated Director Frahm, of Hamburg, upon his invention to prevent ships from rolling. The apparatus consists of U-shaped tanks extending through the hold transversely from port to starboard. The water rises and falls as the ship rolls, with the result that the rythmical movement of the vessel is overcome. In actual tests with steamers the rolling was reduced from 11 degrees to 2 degrees.

Anti-Aeroplane Gun.—An interesting development in guns for the attack of aeroplanes is the McLean-Lissack automatic machine gun, which is capable of firing at war-balloons at an elevation of 75 deg. at the rate of 350 shots per minute. The mechanism is gas-operated, and the piece referred to is mounted on a tripod, with sufficient clearance to allow the operator to lie on the ground and aim by direct sighting at the balloon or aeroplane.

Automobile Economy.—In a recent lecture, William H. Stuart, Jr., showed how largely the fuel economy of an automobile depends on the skill of the driver. He instanced a consumption test made by him over a measured course. In the first test the machine was driven by a driver thoroughly conversant with the mechanism of an automobile. The second test was made with a novice, who was shown only a few of the points of operation, such as are given to a man when he buys a car. The results showed that 34.7 more fuel was used by the inexperienced driver.

Elevated Freight Road for New York—The plan of Calvin Tompkins, Commissioner of Docks and Ferries, for the improvement of Manhattan's west side water front, has met with general approval. The plans contemplate a four-track elevated railroad to extend from Fulton Street to Sixty-third Street, and a series of terminals. Short spurs would lead into new terminals constructed on the east side of the street. Freight would be transferred between trucks and the cars of the new line, and thereby the congestion which now exists on West Street would be avoided.

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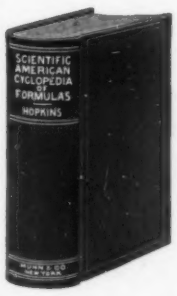

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Aeronautics

Paulhan Wins the Daily Mail Cross Country Prize.—Paulhan received a check of 25,000 francs from the *Daily Mail* recently, as he was declared the winner of the prize for the greatest distance flown across country for the year ending with August, 1910. He also won the $50,000 London to Manchester prize offered by this newspaper, which, all told, has expended $60,000 in prize money, all of which has been captured by the French.

Appropriation by the House.—On Tuesday of last week an appropriation of $375,000 was passed by the House with the stipulation that $125,000 of this appropriation must be used for equipping the Signal Corps with aeroplanes. Representative James R. Mann, of Illinois, offered an amendment to the army bill, thus bringing it before the House. He proposed an appropriation of $250,000 and told how far behind the European powers our country is at the present time in the matter of aeronautics. He called attention to the appropriation of $2,000,000 for dirigibles and aeroplanes and bases from which to operate them that has recently been made by Italy. Representative Mann was obliged to cut in half his appropriation for aeroplanes, but be finally succeeded in raising the original appropriation of $250,000 for Signal Corps equipment to $375,000 with the stipulation mentioned above. It is to be hoped that this bill will pass the Senate, and that Brigadier-General Allen, the chief of the Signal Corps, will be able to carry out his plan of aeroplane stations with twenty machines in different parts of the country.

A New Passenger-carrying Record in France.—On January 17th, Henry Weymann, the young American aviator who has made many records in France, flew from Rheims to Mourmelon and back, a total distance of about 40 miles, with two passengers. He made the outward trip in the morning in an hour and a quarter, but the return journey in the afternoon was covered in 29 minutes. This is a record flight with three men in a machine. Weymann used a Farman biplane with which he has made most of his other notable passenger-carrying flights, the chief of which are the flight from Mourmelon to Paris (105 miles) last September and his cross-country flight for the Michelin Trophy from Paris to Puy-de-Dome mountain, in which he flew 280 miles with a passenger. He almost reached the goal, but was compelled to descend within a few miles of his destination because of a dense fog. At one time last summer he held the altitude record with 4,100 feet.

Ely's Flight to the U. S. S. "Pennsylvania."—On January 17th Eugene Ely made the 12-mile trip from the aviation field at San Francisco to the warship "Pennsylvania," which was anchored in the midst of the shipping of the harbor. A special platform 120 feet long and about 40 feet wide had been erected on the stern of the vessel and canvas shields had been stretched on each side to catch the machine in case it did not land upon the platform. Ropes were stretched across the platform and connected with bags of sand in order to stop the aeroplane in case the special skids with hooks did not work. Ely left the field about 10:30 A. M., climbed 2,000 feet, and crossed the San Bruno hills at a great height. He headed straight for the warship, shut off his motor while some distance up, glided down to the platform, and landed with perfect ease. He had so little trouble in making the landing that he believes he could do it nine times out of ten under moderate weather conditions. After a reception on shipboard Ely returned by aeroplane to the field in 16 minutes. This was the second time he had started a flight from a naval vessel and this time he did not strike the water, but he soared off with no trouble whatever.

Science

The Quantity of Atmospheric Water.—The Weather Bureau has made progress toward the installation of apparatus, especially optical, for the study of the quantity of water vapor through a wide vertical extent of the atmosphere (as distinguished from the purely local indications of the hygrometer and the psychrometer). Spectroscopic observations with this end in view are to be undertaken by Prof. W. J. Humphreys.

A Definition of Exercise.—If you want a definition of exercise, you will find it in an address read by Dr. Albert E. Sterne before the Ohio Valley Medical Association. Under the term exercise he includes "all volitional impulses leading to active bodily effort great or small." Of course he leaves out of consideration "such of them as fulfill merely the necessities of our daily existence as such, also all passive motions which aim at merely therapeutic ends."

Wireless Weather Reports.—Wireless weather reports from vessels are now being transmitted regularly to the Central Meteorological Observatory at Tokyo, and warnings of typhoons and other storms are issued to vessels from that institution by the same means of communication. In spite of the rather discouraging results of the experiments made with wireless last year by the English and German meteorological services, the interest in this development of weather telegraphy remains unabated, and it can hardly be doubted that it will enter the practical stage in a few years.

A Singular Light Effect.—A peculiar light effect was observed by a party of German ski runners who had passed the day in fog and lightly falling snow at an elevation of 4,750 feet above sea level, and who had begun to experience slight symptoms of snow blindness. On entering a hut at dusk and opening the window they say narrow, bright blue bands surrounding the lumps of snow that adhered to their gloves and shoes, and marking the boundaries between light and shade on all parts of their persons and clothing. The effect soon vanished with the fading twilight and not a trace of it was observed on the following day.

A Remarkable Snowstorm.—Mr. H. E. Wood describes in the *South African Journal of Science* for September the remarkable snowstorm that fell in South Africa, August 16th-18th, 1909. The area covered by the storm embraced the south of the Transvaal, the northwest of the Orange River Colony, and the higher parts of Natal. On the morning of August 17th, the town of Johannesburg, for the first time in its history, was covered with snow to a depth of several inches. To many of its inhabitants, especially of the younger generation, the sight of snow was quite new; and the unusual event was celebrated as a general holiday. During the past sixty years there have been only three great snowstorms in the Transvaal, including this one.

Seasonal Snowfall.—During the past two years the Weather Bureau has been experimenting with various devices for measuring the seasonal snowfall in regions remote from human habitation, where it is impossible to make daily observations. This problem is most important in the western States, where the water used for irrigation in summer depends upon the snowfall of the neighboring mountains during the winter. The most satisfactory results have been obtained with what is known as a "snow-bin"—a cubical box five feet on a side, standing on a frame so that the top is ten feet above the ground. The bin is fitted with a system of louvers on the inside to prevent the wind from blowing out the snow and to insure a level deposit within.

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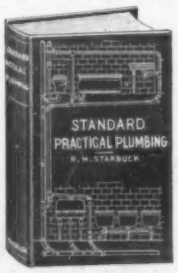

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